# THE TAXONOMY OF TRIPOGANDRA (COMMELINACEAE)[1]

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## INTRODUCTION

Although some species of commelinaceous plants — *Tradescantia* and *Zebrina* — are very well-known in introductory courses in biology and botany for their use in demonstrating cyclosis, plasmolysis, and anther squashes, and while cytologists consider species of *Tradescantia* good teaching material and popular research subjects because of their large chromosomes, taxonomists have not agreed as to generic limits or relationships within the family. The problems of generic delimitation within the Commelinaceae have existed almost since the time of Linnaeus. Concepts have changed through time and even a careful and observant worker such as C. Kunth modified his concepts of the genera during his working years as is evidenced by his transferral of species from one genus to another. In recent years the publications of Aristeguieta (1965), Hutchinson (1959), Matuda (1956), Moore (1960, 1963), Pichon (1946), Rohweder (1956), and Woodson (1942) illustrate the different concepts each investigator has of various genera, especially those American genera related to *Tradescantia*.

*Tripogandra* has been included in what has been called the *Tradescantia* alliance. The United States species of this alliance were studied by Anderson and Woodson (1935) and were found to form a uniform group of species. *Tradescantia* outside of the United States contains diverse elements, and a study of *Tripogandra* was considered in the nature of an introduction to the whole alliance. As

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delimited by Woodson (1942) on the basis of inflorescence structure, *Tripogandra* was not well understood and contained a number of species of questionable affinity. Moore's (1960) investigations showed that some species had a modified androecium which suggested an important biological function probably related to insect attraction, assuring pollination and out-crossing. A detailed study of the species included in *Tripogandra* was thought to be one way of approaching the problem of generic delimitation and of determining the relationship of *Tripogandra* to its closest relatives and to the remainder of the family.

Here I have delimited *Tripogandra* to include only those 20 species which have dimorphic stamens and double cincinni not subtended by foliaceous bracts. These species are described in detail while the other species which have been included in *Tripogandra* at some time in the past are not considered congeneric and are not described in detail. These species and reasons for exclusion are to be found at the end of this paper.

## HISTORICAL REVIEW

*Tripogandra* was first proposed by Rafinesque in 1837 to contain one species, *Tradescantia multiflora*. Rafinesque's publications were not widely available and his taxonomic decisions were not always accepted by other botanists. As a result, the name *Tripogandra* was not adopted by the botanical community until much later. When Rafinesque published *Tripogandra* he also proposed the following as segregants from *Tradescantia: Sarcoperis, Siphonstima, Gibasis, Etheosanthes, Tripogandra* (based on *Tradescantia multiflora* Jacq.), *Phyodina, Leiandra, Heminema* (based on *Tradescantia multiflora* Swartz), and *Aploleia*. Rafinesque concluded his proposals with the following comments:

"These 3 last Genera [*Leiandra, Heminema, Aploleia*] lack the very essential characters of bearded Stam. that once was the only distinction of *Tradescantia* from *Com-*

*melina*, but these 2 Genera are in utter confusion, as the above proves. Compare also my genera of *Commelina*. It is deplorable to see Botanists forcing sp. into genera, in spite of characters. There is not a single generic character common to all the above G. 22 to 32! my reform and revision were indispensable, and begun in 1815. . . . this whole Genus is a mass of linnean errors."

Rafinesque was correct by present criteria in believing that several generically different elements were present in *Tradescantia*, but he did not solve all the problems. Both *Tripogandra* and *Heminema* are based on the same type, though Rafinesque credits two different authors. Rafinesque may have been misled by the apparent though not real differences between Swartz's original description and Jacquin's description and illustration. Woodson (1942) united *Heminema* and *Tripogandra* and his choice of *Tripogandra* must be followed according to Article 57 of the International Code of Botanical Nomenclature (1966).

Kunth in 1843 considered the entire family and described sixty species of *Tradescantia* which he divided into several groups, one being "Species anomalae." This group was characterized by anthers of two shapes, with three longer and three shorter filaments. All of the species in this group are presently considered in the genus *Tripogandra*.

Schlechtendal (1853) proposed the name *Descantaria* for the species which Kunth included in his "Species anomalae." Schlechtendal wrote that those species seen by him were distinguished by three bearded perfect stamens and three beardless imperfect stamens. No combinations were made by Schlechtendal however.

In 1866, Hasskarl used *Disgrega* as a generic name in a key with *Tradescantia disgrega* in parentheses probably indicating that this species belonged to the genus *Disgrega*, but no formal transfer of the species was made.

Clarke (1881) dealt with the Commelinaceae as a family. He divided the genus *Tradescantia* into three sections, one of which was Descantaria, characterized by three longer

and three shorter stamens more or less dissimilar. Clarke (in Donnell-Smith, 1902) described the genus *Donnellia* characterized by a three-valved capsule, locules bearing one seed, and based on *Callisia grandiflora* which was originally described as having two groups of dissimilar stamens. He was prompted to write that in his previous work on the family

> "no attempt is made to deal with the genera 'logically,' the same characters, which in the American genera (*Tradescantia* and its allies) constitute genera, only constitute subgenera in *Commelina* and *Aneilema*. . . . convenience has been preferred to any logical system."

*Donnellia* was found to be a later homonym and Rose (1906) proposed the name *Neodonnellia* for the genus.

Clarke's work has caused concern among taxonomists and Anderson and Woodson (1935) note that Clarke's

> "revision of the genus *Tradescantia* reflects little credit upon the author, when compared with the critical, if eccentric observation of Rafinesque nearly a half century previously. Not only was Clarke satisfied to ignore the complexity of the genus by unwarranted reducing to strict synonymy or ambiguous varieties most of the species proposed by his predecessors, but the literature was complicated by the publication in synonymy of unpublished names of other botanists, and the misinterpretation of numerous others. The revision of the genus in the 'Monographiae' is clearly a piece of chorework reflecting rather a none too laborious attempt at compilation than a lively interest and acuity."

Brückner (1927) chose Schlechtendal's name, *Descantaria*, as the generic name for several of the species now included in *Tripogandra* and formally transferred those species. Brückner had suggested these transfers in 1926 when he had published a complete description of *Descantaria* and gave Schlechtendal credit for proposing the name. No synonyms were given by Brückner until 1930, when

he listed *Descantaria* Schlechtend., *Heminema*, *Tripagandra* [sic] Rafin., and *Disgrega* Hassk. It is not clear why Brückner chose a name which lacked priority. A possible reason is that he had no first-hand knowledge of Rafinesque's publication. Brückner's misspelling of *Tripogandra* is the same as that in Index Kewensis, fasc. 4, which may have been Brückner's only acquaintance with the name.

The American members of the Commelinaceae were treated by Woodson (1942) in an attempt to better delimit the genera. A number of transfers were made in the newly delimited genera, and *Tripogandra* was discussed at length. Woodson suggested new approaches to the family, stating that

"the Commelinaceae always have been difficult subjects for herbarium study because of their deliquescent flowers. It is not easy to understand, therefore, why previous systematists of the family have focused almost their whole attention upon floral structure in the delimitations of subfamilies, tribes, and genera."

Woodson felt that stamens were too variable a character to use for a major subdivision of the family and pointed out Brückner's inconsistency in dividing the family into two subfamilies and then placing *Descantaria* in the Hexandrae and *Neodonnellia* in the Triandrae. I believe Woodson was correct in considering *Descantaria* and *Neodonnellia* as congeneric. Woodson suggested that a major subdivision of the family could be made using inflorescence structure. In his concept of the tribe Commelineae, the ultimate units of the inflorescence are individual scorpioid cymes while in the Tradescantieae the basic structures "are paired sessile scorpioid cymes which appear as a 2-sided unit superficially, . . ." Woodson's concept of *Tripogandra*, which was placed in the Tradescantieae, was based primarily on inflorescence structure so it included more species than I have included. Woodson included species of *Leptorhoeo* and *Cuthbertia* which have six similar stamens because these species lacked foliaceous bracts subtending

the paired cymes. Previous authors and I have considered the two dissimilar whorls of stamens and their position as characters which delimit the most natural grouping of species.

Brückner (1930), Hutchinson (1934, 1959), Woodson (1942), Pichon (1946), Rohweder (1956), and Brenan (1966) have all dealt with the problems of generic definition and the characters used within the family to delimit them. Different emphases were used by each author but in general a consideration of several characters was found necessary for more satisfactory treatments. *Tripogandra* and some of its species have been considered in recent years in studies of restricted scope by Macbride (1936, 1944), Standley and Steyermark (1944, 1952), Matuda (1956), Moore (1960), Bacigalupo (1964, 1967), and Aristeguieta (1965), all of whom have been influenced to some degree by Woodson's work.

The genera of the Commelinaceae have been divided among various groups by the different authors listed above. No general consensus has been reached and all schemes are unsatisfactory to some extent. Brenan (1966) summarized the earlier schemes of classification and has divided the genera into fifteen groups. *Tripogandra* is considered in Group XI, which includes *Rhoeo, Campelia, Callisia, Aploleia, Tradescantia, Phyodina,* and *Cymbispatha.* Using Brenan's criteria, *Tripogandra* seems more closely allied to the species of this group than any other.

## MORPHOLOGY

The morphology of *Tripogandra* has been investigated to varying degrees by taxonomists who have used certain characters in classifying the species, but the genus has never been systematically investigated by a morphologist. Tomlinson (1966) has been a primary investigator of morphology and anatomy having looked at the epidermis, hairs and stomatal patterns of three species. Brückner (1926) described in some detail the species *T. glandulosa*

(as *Tradescantia pflanzii*). More recently Rohweder (1963a) investigated shoot development and the course of vascular bundles near the apex of *Tripogandra pflanzii* (=*T. glandulosa*).

The following observations have been made on herbarium specimens and on living plants collected in México or grown in the greenhouse.

*Habit.* The plants of *Tripogandra*, whether annual or perennial, are succulent, weak-stemmed herbs. The plants may have an erect stem which is either branched or not. In erect, annual species — *T. amplexicaulis*, *T. angustifolia*, *T. guerrerensis*, and *T. palmeri* — branches may or may not develop from axillary buds. Plants in sunny, moist locations branch frequently. Crowded plants or those in shaded locations are commonly unbranched. Because the base of the plant is small and there is no secondary growth it is unable mechanically to support the weight of later growth. The base of the plant, therefore, becomes decumbent and additional support and anchorage is gained by the production of adventitious roots at the nodes of the decumbent stem. The presence of an intercalary meristem at the base of each internode allows the main stem to remain upright through differential growth and bending in these areas.

Some species, e.g. *Tripogandra disgrega*, *T. saxicola*, and *T. purpurascens*, may be either erect or trailing. This habit seems to be partly under genetic control; some plants have sturdier stems and grow upright while others produce weak, flexible stems which trail over the ground.

Perennial species such as *Tripogandra montana* and *T. serrulata*, commonly trail over the ground to a length of as much as two meters, producing adventitious roots at nearly every node which touches the soil. The flowering stems usually are erect. Branching occurs at irregular intervals. A vegetative branch is often produced from a node below the inflorescence. After growth of this axillary branch, the inflorescence appears to be borne in a lateral position, but

close examination shows the vegetative shoot to be in an axillary position and the inflorescence to be terminal.

*Tripogandra grandiflora* produces long upright shoots which are often supported by surrounding woody vegetation. Sheathing bracts or cataphylls are borne on the lower portions of the stem. Structures transitional between the cataphylls and a typical vegetative leaf can be found on most stems.

*Root.* All species of *Tripogandra* have fibrous roots. Thickened storage roots such as are found in species of other genera, i.e. *Tradescantia, Gibasis, Setcreasea, Separotheca, Dichorisandra,* and *Commelina,* have not been observed in any species of *Tripogandra.* The roots may be produced only at the base of the plant or they may be produced adventitiously from nodes along the length of the stem. Root initials may be differentiated early and remain dormant as has been reported by Tomlinson (1969) for species of *Tradescantia.*

*Stem.* The stems of all species of *Tripogandra* are more or less succulent structures. The stems as well as most other organs contain a mucilaginous juice which is exuded when the structures are crushed or broken. A common feature of most species is the presence of a line or band of hairs extending down one side of the internode (Fig. 4). The hairs within this line are always uniseriate, i.e. composed of several cells joined end to end. The terminal cell is not enlarged or modified in shape from the cells below it. This line of hairs is continuous with the line of hairs present on the sheath of the leaf above and is always found on the side of the stem opposite the leaf blade of that sheath. The line of hairs on the internode may extend the full length of the internode as in *T. saxicola,* may extend for part of the length of the internode as in *T. serrulata,* or occasionally may be lacking as in *T. grandiflora* or *T. amplexicaulis.*

Elsewhere hairs may be more or less uniformly scattered over the surface of the stem, as in *Tripogandra purpurascens* subsp. *australis,* or the stem may be glabrous as in

*T. grandiflora.* When present, the hairs may be uniseriate and resemble those in the line on the internode or they may have an enlarged distal cell and be called capitate as in *T. encolea.*

*Leaf.* The leaves of *Tripogandra* species are simple. The base is sheathing, forming a complete tube which is closely appressed to the internode. The leaf surface may be glaucous as seen in *T. amplexicaulis* and *T. amplexans,* but is more usually bright green and shiny. The dorsiventral blade is broad and flattened in all species except *T. angustifolia,* where the lamina is C-shaped or terete in cross-section and in *T. purpurascens* where the lamina is complicate. The base of the blade may be variously modified. It may be narrowed and subpetiolate as seen in some collections of *T. amplexicaulis* and *T. disgrega.* In some species, particularly on the stem just below the inflorescence, the base may be amplexicaul and surround the stem producing a superficially perfoliate appearance as in *T. amplexicaulis, T. amplexans,* and *T. encolea.* In other species — *T. diuretica, T. montana,* and *T. serrulata* — the leaf base is oblique, often rounded on one side and cuneate on the other.

Arrangement may be spiral as in *Tripogandra guerrensis* and *T. disgrega* or two-ranked (distichous) as most obvious in *T. grandiflora.*

The leaves may be glabrous or variously vestite and the vesture may be constant or variable within a species. The uniseriate hairs may be distributed on the leaves in the following fashions:

1. Both surfaces (abaxial and adaxial) as in some plants of *T. disgrega* and *T. diuretica;*
2. Abaxially (dorsally) as in *T. brasiliensis;*
3. Adaxially (ventrally) as in *T. saxicola;*
4. On the ventral surface over the midvein as in *T. serrulata* and *T. montana;*
5. Adaxially in a line near the margin as in some plants of *T. multiflora.*

Distribution of hairs is most variable in *Tripogandra multiflora* and is described further under that species.

The margins of blades are usually ciliate with uniseriate hairs except for some plants of *Tripogandra grandiflora* and *T. angustifolia*. Marginal hairs may vary in shape from species to species and have been illustrated for several species by Bacigalupo (1967). The distribution of marginal hairs may be regular or irregular, the latter condition being most apparent in *T. angustifolia*. The length of the hairs varies within species.

The orifice of the leaf sheath is villous in most species, although it may be glabrous in *Tripogandra amplexicaulis* and *T. grandiflora*. The hairs are multicellular and uniseriate and intergrade with those of the leaf margin.

Tomlinson (1969) has reported that a strand of collenchyma extends along the leaf margin in *Tripogandra*. In living material this strand can be seen as a light-colored line and is especially obvious in *T. grandiflora*.

The upper epidermis is colorless and the cells may be larger than any within the leaf. This phenomenon has been reported by Brückner (1926) for *Tripogandra pflanzii* in his description of leaf anatomy; I have seen these enlarged cells in *T. angustifolia* and *T. montana*. Tomlinson (1966, 1969) has found this specialized epidermis in several genera and assumes the function to be that of water storage.

The presence of silica bodies in the epidermis has been noted by Brückner (1926) and Tomlinson (1966, 1969).

The stomata have been described by Brückner (1926) and Tomlinson (1966, 1969) as having two accessory cells adjacent to the guard cells.

A weakly developed palisade layer may be seen in *Tripogandra montana* but is lacking in *T. angustifolia*.

*Inflorescence*. The basic inflorescence unit which appears throughout the family is the cincinnus according to Brenan (1966). The cincinnus as defined by Rickett (1955) is "a monochasium in which flowers appear alternately to right and left along one side of a sympodial axis."

The cincinni of a plant may be arranged in various patterns to form more complex, compound inflorescences. Brenan (1966) has illustrated some of the inflorescences in other genera.

The basic unit of the inflorescence in *Tripogandra* is also the cincinnus, but throughout the genus two cincinni occur fused together as in several other genera, e.g. *Tradescantia*, *Setcreasea*, *Rhoeo*, and *Zebrina*. The type of inflorescence has been called the "einfache Wickel zu zweien" by Brückner (1926), paired cymes or 2-sided cincinni by Woodson (1942), "Wickelpaare" by Rohweder (1956, 1963b), paired cincinni by Moore (1963) and dichotomous cymes by Mericle and Mericle (1969).

The constant, paired nature of the cincinni in several genera has been described by Brenan (1966) as "a peculiar fusion of each pair into a characteristic bifacial unit concrescent with its peduncle." Brenan has used the term "paired cincinni" to include structures which are bifacial as in *Setcreasea* and *Zebrina*, as well as geminate as seen in *Gibasis geniculata* where the inflorescence is characteristically composed of two separate and discrete cincinni each on an elongate peduncle.

I have used the term "double cincinnus" to refer to the bifacial, two-sided structure of the inflorescence which occurs in *Tripogandra*. The difference may be subtle but "double" seems to imply more in the nature of fusion than does "paired." Brückner (1926) used the term "Doppelwickel" which could be directly translated as double cincinnus. According to Rohweder's (1963b) translation, Brückner's definition of Doppelwickel was a structure "composed of two cincinni arising from the same node and being opposite in a strict morphological sense." Rohweder and Brenan consider this concept erroneous. My use of the term double cincinnus, if it arises through the fusion of two separate cincinni, may conflict with Brückner's concept of the origin of this structure. The origin of the bifacial structure has not yet been demonstrated.

The problem of terminology is further confused by Rickett's (1955) illustration of paired cincinni in *Myosotis scorpioides*. The structure shown corresponds to Brückner's Doppelwickel which I believe can be seen in the atypical inflorescences sometimes produced in *Gibasis karwinskyana*. I have chosen the term double cincinnus in lieu of a better term.

According to the definition of a cincinnus, each flower is terminal and the continuing axis is always an axillary one. This seems to be true for *Tripogandra*. The pedicel of each flower apparently bears a bract. In the axil of this bract a bud develops which is terminated by a flower which also bears a bract on its pedicel. The small bracts found on the top of the peduncle of all *Tripogandra* species represent these bracts.

The double cincinnus always seems to terminate a stem. Other shoots terminated by double cincinni may or may not be produced at lower nodes. A short shoot bearing several double cincinni may develop in a leaf axil, as in *Tripogandra multiflora* and *T. montana*, giving the impression that several double cincinni arise at a node. Close inspection shows the true nature of the situation. The double cincinni of *T. guerrerensis* are produced in a larger, much branched inflorescence so the appearance of the whole is that of a large panicle.

The number of flowers produced per double cincinnus is variable. The cincinni of some species — *Tripogandra montana, T. serrulata* — are long-lived, producing many flowers over a long period of time, and the sympodial cincinnus axis may become one or two centimeters long. On the other hand, *T. guerrerensis* and *T. amplexans*, produce only a few flowers on each ultimate unit over a short period of time.

The peduncle of the inflorescence may be either glabrous or variously vestite. The hairs may be in lines or bands and/or scattered. Hairs borne in lines or bands are always uniserate (*T. serrulata*), but the scattered hairs may be

either uniseriate (*T. multiflora*) or capitate (*T. amplexicaulis*). The peduncle length is variable, probably being determined both genetically and environmentally.

*Flower.* The flowers of all *Tripogandra* species follow the typical monocotyledonous pattern — three sepals, three petals, six stamens in two whorls or three stamens and three staminodes, and three carpels.

The sepals, which are usually green, contain one median vascular bundle and are more or less boat-shaped or hooded near the apex. The margin is hyaline and may or may not be pigmented. The sepals may be glabrous or nearly so (Fig. 3) as in *T. guerrerensis* and *T. grandiflora*, densely pilose with capitate hairs as in *T. glandulosa* and *T. purascens* (Fig. 1), pilose with uniseriate hairs as in *T. saxicola* (Fig. 2), or they may have only a few hairs at the apex as in *T. diuretica*. The hairs, when present, are often of diagnostic value. At anthesis the sepals may be reflexed but they close when the petals deliquesce.

The petals in all species are larger than the sepals and, depending on the taxon, vary in color from white to dark pink or magenta. Both white and pink flowers have been observed in *Tripogandra angustifolia*, *T. purpurascens* and *T. serrulata*. The petals remain open for only a few hours, commonly opening in the morning except for *T. saxicola* which flowers in the afternoon. All petals deliquesce a few hours after opening. The cell membranes apparently become permeable or break down during deliquescence allowing the cytoplasm to seep out of the cells as drops of liquid. The cell walls remain but the petal as a whole shrivels to a crumpled mass. The veins of the petals are difficult to distinguish in living material.

The androecium is dimorphic in all species; in bud it is actinomorphic but at anthesis it becomes zygomorphic as described below. The outer whorl of the androecium is always opposite the sepals and is composed of fertile stamens with short filaments (Fig. 25). The filaments are more or less subulate or awl-shaped and may be glabrous

as in *Tripogandra grandiflora* (Fig. 8) or bear one to many multicellular hairs on the dorsal surface (Figs. 10, 5). The number of hairs is variable within a species and has not been used as a taxonomic character. In dried material these hairs are almost impossible to detect. In the living state the cells of the hairs are variable in shape so the hairs may appear as long, uniseriate structures as in *T. palmeri* (Fig. 13) or as the classical moniliform hairs as in *T. purpurascens* (Fig. 5). The cells of the hair may be colorless, white, or pink.

The distal end of the filament forms the connective of the anther and the connective is usually somewhat expanded and thickened as is easily seen in *Tripogandra grandiflora* (Figs. 8, 9). Anther sacs are borne on the ends of the connective (Fig. 14). The anthers are usually extrorse in bud, but during anthesis bending of the distal end of the filament causes the anthers to become introrse or, with less bending, pollen is exposed upward. Dehiscence is longitudinal in all species (Fig. 8). The pollen is spherical to oblongoid and monosulcate.

The structures of the inner whorl of the androecium are borne opposite the petals (Fig. 25) and may be either staminodes which produce no functional pollen or stamens with functional pollen. In all species the filaments of these stamens or staminodes are longer than the filaments of the outer whorl of stamens. The filaments may be glabrous as in *Tripogandra guerrerensis* (Fig. 17) and *T. palmeri* (Figs. 21, 22), or variously bearded. The hairs may be borne on the dorsal surface as in *T. saxicola* (Fig. 20), around the filament as in *T. serrulata* (Fig. 19) and *T. montana* (Fig. 31) or in two more or less discrete patches as in *T. grandiflora* (Fig. 28). In all species the hairs are borne more abundantly on the middle or distal end of the filament. The cells of the hairs are usually spherical, producing the typical moniliform hairs, or cylindrical, producing uniseriate hairs as in *T. grandiflora* (Fig. 28). The cells of one hair are usually variable in shape and size, those at the base commonly being cylindrical while the

distal ones may be either cylindrical or spheroidal depending on the species. The cells may appear white, pigmented, or colorless.

The filaments of the stamens or staminodes of the inner whorl are bent to varying degrees. In all species two of the filaments bend at the base around the filaments of two outer stamens so the inner stamens or staminodes become aligned near the third inner stamen or staminode in front of the upper petal (Fig. 16). In addition, all filaments are bent in the middle. In *Tripogandra palmeri* the bend is C-shaped (Fig. 21); in *T. serrulata* (Fig. 19), *T. grandiflora* (Fig. 28), and *T. montana* (Fig. 31) the bend is an open S-shape; while in *T. guerrerensis* (Fig. 17), *T. amplexicaulis*, *T. amplexans* (Fig. 26), and *T. angustifolia* (Fig. 30) the bend is a more pronounced S-shape. The filament may be more or less expanded and inflated distally as in *T. amplexicaulis* (Fig. 23) or cylindrical as in *T. serrulata* (Fig. 19).

The connective and filament form a continuous structure in *Tripogandra palmeri* (Fig. 21) but the filament is very thin distally in species such as *T. guerrerensis*, *T. amplexicaulis*, and *T. angustifolia* (Fig. 27), and the anther then is more or less versatile. The connective may be elongate and straight, bent in the middle to form a V- or C-shape, or discoid. The anther sacs are borne on the ends of the connective and form a small part of the anther. Dehiscence is longitudinal.

The pollen from anthers of the outer whorl of the androecium may be fertile as in *Tripogandra serrulata* or modified and sterile as in *T. grandiflora* or *T. guerrerensis*. Lee (1961) first described the pollen within an anther of tetraploid *T. grandiflora*. This pollen varies in shape from nearly spherical to oblongoid to sub-fusiform and absorbs stain differentially from aniline blue-lactophenol. The pollen of diploid *T. grandiflora* stains uniformly, is more or less spherical, but is larger and has a more sculptured surface as compared to the pollen of the fertile stamens. The variation in pollen shape is greatest

in *T. amplexans* but within any one anther the pollen grains are uniform. Some collections produce spherical pollen which is externally indistinguishable from that of the outer whorl of stamens. In other collections the pollen grains are oblongoid or fusiform.

The gynoecium of the *Tripogandra* flower is composed of three fused carpels. Each carpel is supplied by three vascular bundles, two ventrals and one dorsal. Placentation is axile and two orthotropous ovules are borne in each of the three locules (Fig. 49). A short filiform style is found in all species. The shape of the stigma may be constant or variable within a species. The stigma may be simple and represent the top of the style, may be slightly enlarged (capitellate), greatly enlarged (capitate), or slightly penicilliform. In some plants the stigma may be somewhat three-lobed.

The pistil matures to form a loculicidal capsule which splits down the dorsal surface of each carpel. One to six seeds may be produced in each capsule. The lower ovule never matures in *Tripogandra palmeri*, consequently a maximum of three seeds is produced in each capsule of this species.

The orthotropous ovules develop into seeds with a dorsal embryotega. The embryotega represents that part of the integuments which lies over the embryo. In all species the position of the embryo is readily observed and is seen to be situated on the side of the seed opposite the hilum. The micropyle is also located on the side opposite the hilum — the embryo, in fact, develops just below the micropyle. As has been pointed out by Brückner (1926) for the family and as shown by Chikkannaiah (1962, 1963, 1964, 1965a, 1965b) from embryological studies of *Commelina*, *Murdannia*, *Floscopa*, and *Tinantia*, the relationship between the micropyle, the embryo and the embryotega is a constant one. In *Tripogandra palmeri* (Fig. 72) and *T. grandiflora* (Figs. 76, 77) the embryo and embryotega protrude from the surface of the seed but the margins of the seed are revolute and the embryo is more or less

surrounded and protected from mechanical damage. In other species of *Tripogandra*, the embryo is impressed and completely surrounded by the remainder of the seed. While the position of the embryotega is uniform within the genus it varies within the family. No detailed studies have been made of embryology and development of the seeds of *Tripogandra*.

The seeds of most species of *Tripogandra* are trigonal in outline. *Tripogandra amplexans* has seeds which are variable and they may be either trigonal (Fig. 59) or rectangular (Fig. 58) in outline. The seeds of *T. palmeri* and *T. grandiflora* are unique in having revolute margins. *Tripogandra palmeri* has the margin revolute in three places (Fig. 72), while *T. grandiflora* has the two opposite margins revolute (Figs. 76, 77). Seed outline is also dependent on the number of seeds which develop in a locule. The seeds become trigonal if both ovules develop (Fig. 76) but are more elliptical if only one develops (Fig. 77). The single ovules usually develop into larger seeds.

The appearance of the surface of the seed coat is of taxonomic value. Following the terminology of Murley (1951) the following categories of seed surface texture may be recognized among the species of *Tripogandra:*

1. Reticulate: *T. serrulata* (Figs. 38, 39), *T. montana* (Figs. 44-46);
2. Reticulate-foveate: *T. multiflora* (Figs. 32-35), *T. warmingiana* (Fig. 61);
3. Ribbed reticulate-foveate: *T. glandulosa* (Figs. 42, 43);
4. Areolate: *T. palmeri* (Figs. 72, 73), *T. saxicola* (Figs. 56, 57);
5. Ribbed areolate: *T. amplexans* (Figs. 58-60), *T. brasiliensis* (Figs. 47, 48), *T. disgrega* (Figs. 52, 53), *T. guerrerensis* (Figs. 68-71), *T. purpurascens* (Figs. 50, 51, 54, 55);
6. Farinose: *T. grandiflora* (Figs. 76-78);
7. Ribbed farinose: *T. angustifolia* (Figs. 74, 75).

The seeds of *Tripogandra amplexicaulis* are somewhat variable and are generally areolate but some collections have seeds which are also distinctly alveolate (Figs. 64, 65).

*Tripogandra diuretica* (Figs. 40, 41) produces seeds which are more or less intermediate between the ribbed areolate and the reticulate-foveate conditions and which could be called ribbed areolate-foveate.

The outline of the hilum may be punctiform (nearly circular) as in *Tripogandra angustifolia* (Fig. 75), *T. disgrega* (Fig. 53), *T. diuretica* (Fig. 41), *T. multiflora* (Figs. 33, 35), and *T. purpurascens* (Figs. 51, 55), linear as in *T. grandiflora* (Fig. 78) and *T. palmeri* (Fig. 73), or elliptical as in *T. brasiliensis* (Fig. 48) and *T. guerrerensis* (Figs. 69, 71). The outline of the hilum is constant within a species and is useful taxonomically.

The germination of *Tradescantia virginiana* (as *T. virginica*) has been described and illustrated by Gravis (1898) and that of *Commelina virginica* has been described by Bates (1939) but no previous studies have been made of *Tripogandra*. I have observed germination in detail in two species, *T. amplexans* and *T. purpurascens*. There are no significant visible differences in germination among the three genera.

When the seeds are wet they swell slightly and within a few days the seedling emerges. Studies by Chikkannaiah (1962, 1963, 1964, 1965a) of *Commelina*, *Murdannia* and *Floscopa*, as well as those by Gravis (1898) of *Tradescantia* show the radicle of the embryo situated directly below and adjacent to the micropyle and embryotega. I have observed, as did Bates and Gravis, that the radicle emerges from the seed first. The embryotega may be pushed to one side or lifted free from the seed and cap the root tip (Fig. 24). Through further growth the remainder of the embryo emerges from the seed. The tip of the cotyledon remains in the seed, presumably as an absorbing structure, while the cotyledonary neck or petiole elongates further. The first true leaf emerges from the sheathing base of the

cotyledon. By elongation of the radicle and first node, the seed and cotyledonary petiole may be lifted above the ground level.

## CYTOLOGY

The cytological relationships of various Mexican Commelinaceae as well as a review and sumary of previous investigations are discussed in Handlos (1970).

*Tripogandra* is cytologically distinct from other genera. Karyotypes show both telocentric and metacentric chromosomes as well as larger and smaller chromosomes. The basic chromosome number is probably eight, though Jones and Jopling (1972) indicate the additional possibility of 13. Diploid chromosome numbers range from 16 to 64. Two species, *T. montana* and *T. saxicola*, with haploid numbers of 21 may be allopolyploids based on the numbers 8 and 13.

## BREEDING SYSTEMS AND POLLINATORS

The genus *Tripogandra* is characterized by a distinctively modified androecium as was pointed out by Moore (1960). He suggested that the arrangement of stamens and staminodes, in addition to the self-sterility of the clone studied, indicated dependence on insect pollinators and the necessity of out-crossing in the species. Several other commelinaceous genera, including *Aneilema, Cochliostema, Commelina, Tinantia,* also exhibit various androecial modifications. Few studies have been made on the relationship between insects and the androecium in the Commelinaceae. Pollination has been studied in *Commelina* (Breitenbach, 1885), *Tinantia* (Knuth, 1906) and *Tradescantia* (Kerner von Marilaun, 1894; Sinclair, 1968).

From a series of 166 interspecific crosses involving *Tripogandra amplexans, T. angustifolia, T. palmeri,* and *T. purpurascens* subsp. *purpurascens* made in 1966, no interspecific hybrids were obtained. Flowers were bagged to exclude insects. All species studied proved to be self-

fertile. Further observations of *T. amplexicaulis, T. disgrega, T. diuretica, T. glandulosa, T. guerrerensis, T. montana, T. multiflora, T. saxicola,* and *T. serrulata* growing in insect-free greenhouses show that these species are also self-fertile. Of the 14 species observed, only *T. grandiflora* is self-sterile.

In 1967, I observed natural populations of *Tripogandra amplexans, T. amplexicaulis, T. angustifolia, T. disgrega, T. grandiflora, T. guerrerensis, T. montana, T. purpurascens, and T. saxicola* in México for a total of 61½ hours. Two hundred thirty-seven insects were observed of which 158 were captured. These insects are now in the collections of the Department of Entomology, Cornell University, as "Lot no. 994."

Hymenopterous insects formed the largest category of visitors. There were 60 individuals in the Apidae, 48 in the Halictidae, 20 in the Andrenidae, 4 in the Anthophoridae, 1 in the Coletidae. The bees formed the largest and most active group of insects and should be considered the most important pollinators. Bees only engaged in gathering pollen since the plants do not produce nectar. Some individual bees visited only the longer stamens (staminodes), others visited only the shorter, while still other bees crawled over all stamens and gathered pollen indiscriminately.

In only one species did I observe that the position of the staminodes caused bees to move in a restricted fashion in the flower. In *Tripogandra guerrerensis* the petals are not arranged symmetrically but instead at anthesis the two lower petals bend away from each other and are located nearer the upper petal; in this way an angle of approximately 90° is formed between either of the lateral petals and the upright petal, while the two lower petals are separated by 180°. The three staminodes arch out over the stamens and ovary. A bee can approach the stamens only by clinging upside down to the filaments of the staminodes. The significant position seemed to be that assumed when a bee was clinging to the staminodes and gathering pollen

from the anthers. The insect's abdomen then touched the anthers and pollen adhered to its body. It seems likely that pollen could be carried from flower to flower in this fashion and cross-pollination would thus occur. The significance of cross-pollination remains to be demonstrated in this species because these plants are also self-fertile. In other plants, Allard (1965) has shown that a large amount of variability is maintained though only a small percentage of outcrossing occurs. He believed that most individuals of a self-pollinating population would be highly homozygous but the recombination of genes introduced by a low level of outcrossing would provide sufficient new genotypes adapted to the microhabitats which occur in an area and would allow for increasing fitness of the species to a specific niche. Such reasoning may be applied to the annual and perennial self-fertile species of *Tripogandra* but further investigations should be conducted to determine the basic facts.

Some bee species, even when collected in small numbers, were found to visit two or more species of *Tripogandra*. One species of *Dialictus* was collected from four different species of *Tripogandra;* one species of *Pseudopanurgus* and another species of *Dialictus* were collected from three *Tripogandra* species, while three other *Dialictus* species, one species of *Evylaeus*, *Augochlora* near *smaragdina*, *Trigona fulviventris*, *T. mosquito frontalis*, and *T. testacea orizabaensis* were collected on two species of *Tripogandra*.

Many of the bees collected in this study are solitary bees which have been reported (Linsley, 1958) to be most abundant in warm semi-desert regions of the world. Many habitats in México can be described as warm and arid or border semi-desert or desert regions which may account for the many solitary bee species collected. The majority of solitary bees are oligolectic (Linsley, 1958) (oligotropic fide Faegri and van der Pijl, 1966), i.e. utilize only a few related species of plants as food sources. The social bees, *Trigona* and *Apis*, are probably polylectic (polytropic fide Faegri and van der Pijl), i.e. utilize food from un-

related plant sources. *Trigona mexicana* and *T. acapulconis* were both collected at one location in México. Some individuals were found on *Tripogandra* and others were caught on an abundant composite.

*Tripogandra grandiflora*, the only demonstrated self-sterile species produces strongly fragrant flowers. *Tripogandra amplexicaulis*, *T. saxicola*, and *T. purpurascens* subsp. *purpurascens* are *very* faintly scented. The scents produced may allow bees to identify and return to a specific source of pollen or, in the case of *T. grandiflora*, may allow bees to locate the plant because of its odor.

Of 23 dipterans collected, 18 were in the family Syrphidae. Faegri and van der Pijl consider these flies to be irregular and not very active pollinators. In *Tripogandra* I would confirm this observation. The three dipterans in the family Bombyliidae may effect some pollination but the remaining two flies and three beetles were probably not visiting the flowers for pollen and should not be considered to be important pollinators.

## MEASUREMENTS

To prevent misunderstandings and to provide for consistent results I am giving below the methods by which I obtained my measurements. The length of the leaf blade is the distance from the tip of the leaf to the top of the sheathing leaf base. The length of the sheath is measured from the line of attachment at the node to the lowest point on the orifice of the sheath; this point is always on the side opposite the lamina. The diameter of the leaf sheath reflects varying amounts of inaccuracy because these measurements are from dried, pressed specimens. If the specimen is flattened and well-pressed, the measurement will be greater than the diameter in the living plant; if the stem is not well-flattened, the measurement may be close to that in the living state or even somewhat smaller. In either case, the sheath seems to shrink less than the stem during drying and is a more accurate esti-

mate of stem diameter than a direct measurement of the dried stem. The length of the peduncle is the distance between the subtending leaf and the base of the bracts at the distal end of the peduncle. The length of the pedicel is measured on flowers at anthesis. Anthesis is a definable period of a few hours duration and is used because it provides a uniform standard which is not subject to personal bias. Pedicels may elongate in fruit but a measurement standard would be more difficult to define. Measurements of flower parts are made on flowers at anthesis for the same reasons given above. The length of the filaments is the linear distance from the base to the connective disregarding curves and bends. The length of the anthers is the distance represented by the length of the anther sacs, while the width is taken as the distance between the anther sacs on the same anther. Pollen viability is judged by pollen stainability in aniline blue-lactophenol. The length of the ovary is the distance between the base of the ovary and the base of the style. The length of the style includes the stigma. The length of the capsule does not include the persistent style.

## SYSTEMATIC ACCOUNT

**Tripogandra** Rafinesque, Flora Telluriana 2:16. 1837 ('1836'). TYPE: *Tradescantia multiflora* Swartz.

*Heminema* Rafinesque, Flora Telluriana 2:17. 1837 ('1836'). TYPE: *Tradescantia multiflora* Swartz.

*Descantaria* Schlechtendal, Linnaea 26:140. 1853; Brückner, Bot. Jahr. Syst. Beiblatt 137, 61:60, 61. 1926. LECTOTYPE: *Tradescantia multiflora* Swartz.

*Disgrega* Hasskarl, Flora 49:215. 1866. TYPE: *Tradescantia disgrega* Kunth.

*Donnellia* Clarke in Donnell-Smith, Bot. Gaz. 33:261. 1902; non Austin (1880). TYPE: *Callisia grandiflora* Donnell-Smith.

*Neodonnellia* Rose, Proc. Biol. Soc. Wash. 19:96. 1906. TYPE: *Callisia grandiflora* Donnell-Smith.

Fibrous-rooted annuals and perennials, stems usually branching monopodially, erect or trailing, internodes cylindrical, glabrous or variously vestite, often with a line of uniseriate hairs extending down one side.

Leaves with a tubular sheathing base; blade narrowly ovate to ovate (linear in *Tripogandra angustifolia*), usually flat but complicate in *T. purpurascens* and C-shaped or terete in *T. angustifolia*, usually fleshy, glabrous or variously vestite with uniseriate hairs, base cuneate, rounded, oblique, or amplexicaul, sometimes narrowed and subpetiolate, apex acute, sometimes acuminate; sheath glabrous to pilose, orifice glabrous or more often villous with long uniseriate hairs, usually with a line of uniseriate hairs extending down the side opposite the blade and continuing to the internode below.

Inflorescences composed of a single terminal or a terminal and a few axillary double cincinni, or a terminal panicle of double cincinni; peduncles with or without 1-2 lines of uniseriate hairs, otherwise glabrous to densely pilose, hairs uniseriate or capitate; pedicels erect or reflexed in fruit, glabrous to pilose, hairs uniseriate or capitate; bracts at the base of the pedicels small, a thin band of tissue which is glabrous to pilose with capitate or uniseriate hairs, margin entire, denticulate, with a few uniseriate hairs, or ciliate.

Flowers white to bright pink or magenta; sepals three, cymbiform, ovate, elliptic, or obovate, apex acute or obtuse, glabrous to pilose, margin hyaline, entire; petals three, ovate, elliptic, or obovate, with acute, rounded, obtuse, or irregular apex, deliquescing a few hours after anthesis to a shapeless mass; androecium actinomorphic in bud becoming zygomorphic at anthesis, composed of six stamens or three stamens and three staminodes in two whorls, the outer whorl always of stamens and opposite the sepals, shorter, with glabrous or variously bearded filaments about equalling the pistil; anthers extrorse in bud, becoming either introrse at anthesis or horizontal and then shedding pollen upward toward the stigma, dehiscing longitudinally,

connective usually short and inconspicuous, pollen usually fertile; inner whorl of stamens or staminodes opposite the petals, longer, filaments glabrous or variously bearded with uniseriate or moniliform hairs, variously curved and bent, two filaments bending at the base toward the third inner stamen-staminode around the filaments of the two outer intervening stamens so the inner stamens-staminodes are all in an erect position in front of the upper petal at anthesis, anthers dehiscing longitudinally, connective short and inconspicuous or elongate, straight or bent in a C- or U-shape, pollen fertile or sterile.

Ovary globose or cylindrical, somewhat flattened on three sides, glabrous, trilocular, placentation axile with two orthotropous ovules per locule, style shorter than the ovary, filiform, stigma simple, capitellate, or capitate.

Fruit a loculicidal capsule with persistent style; seeds usually 2 per locule (1 in *Tripogandra palmeri*, 1-2 in *T. grandiflora*), usually triangular, the surface variously reticulate or roughened, hilum punctiform, elliptic, or linear, embryotega dorsal, protuberant or impressed.

## KEY TO THE SPECIES

a. Leaves terete or C-shaped in cross section, linear in outline, less than 2.7 mm wide, red or green; testa ribbed farinose. ..... 3. *T. angustifolia.*

a. Leaves flat or complicate, never terete, mostly broader than 3 mm, green. ..... b.

b. Nodes below the inflorescences bearing amplexicaul leaves; leaves flat, never complicate. ..... c.

c. Plants perennial; upper internodes pilose; hilum punctiform to elliptical. ..... 7. *T. encolea.*

c. Plants annual; upper internodes glabrous or with a line of uniseriate hairs; hilum linear. .... d.

d. Petals bright pink; plants tall, to 92 cm high; leaves of stem below amplexicaul leaves to 14.8 cm long, occasionally subpetiolate; peduncles pilose; seeds usually with an alveolate surface, convex dorsally. . 2. *T. amplexicaulis.*

d. Petals white or pale pink; plants shorter, to 58.5 cm high; leaves below amplexicaul leaves to 7.8 cm long, rounded or cuneate at the base; peduncles often glabrous; seeds never with alveolate surface, flattened dorsally. ..... 1. *T. amplexans.*

b. Nodes below the inflorescences without amplexicaul leaves or if amplexicaul then also complicate. .. e.

e. Filaments of inner (longer) staminal whorl glabrous. ..... f.

f. Sepals glabrous or nearly so; seeds two per locule, the upper larger, hilum linear, testa ribbed, areolate; inflorescence an open panicle. ..... 10. *T. guerrerensis.*

f. Sepals with scattered capitate hairs or pilose; seeds in each locule equal in size or only one per locule and then the margins revolute; inflorescence of double cincinni variously arranged but never in an open panicle. .. g.

g. Hilum linear, seeds one per locule with margin revolute; pedicel erect in fruit. ..... 15. *T. palmeri.*

g. Hilum punctiform, seeds usually 2 per locule, lacking revolute margins; pedicel reflexed in fruit. ..... h.

h. Leaf base oblique; testa reticulate but not ribbed; capsule obovoid, slightly stipitate. ..... 19. *T. silvatica.*

h. Leaf base not oblique, but instead cuneate to rounded; testa ribbed; capsule globose or obovoid, not stipitate. ..... i.

i. Testa prominently ribbed reticulate-foveate; longer filaments concave in upper third, to 3.3 mm long; seeds 0.8-1.4 mm long. ..... ..... 8. *T. glandulosa.*

i. Testa ribbed areolate; longer filaments inflated in upper portion, to 8.0 mm long; seeds 1.2-2.1 mm long. ..... j.

j. Calycine hairs long, some 1.5-4.5 mm long; leaves usually flat; peduncle usually glabrous; dorsal seed surface convex. ..... ..... 5. *T. disgrega.*

j. Calycine hairs short, the longest less than 1.0 mm long; leaves complicate; peduncle variously glabrous, pilose, with or without lines of hairs; dorsal surface of seed flat or concave. . k.

k. Internodes glabrous except for a line of uniseriate hairs down one side, rarely the upper internodes with scattered hairs. ..... ..... 16a. *T. purpurascens* subsp. *purpurascens.*

k. Internodes all with scattered capitate hairs and a line of uniseriate hairs down one side. . 16b. *T. purpurascens* subsp. *australis.*

e. Filaments of inner (longer) staminal whorl bearded, never glabrous. ..... l.

l. Hairs of the filaments uniseriate, never moniliform; hilum linear, testa farinose. ..... ..... 9. *T. grandiflora.*

l. Hairs of the filaments moniliform; hilum punctiform or elliptical. ..... ..... m.

m. Filaments of longer stamens inflated; leaf base subpetiolate, oblique; testa ribbed areolate, hilum elliptical. ..... ..... 4. *T. brasiliensis.*

m. Filaments of longer stamens terete, never inflated; leaf base various; testa not ribbed except *T. diuretica*, hilum punctiform (occasionally elliptical in *T. saxicola* and *T. diuretica*). ..... n.

n. Lamina of leaf cuneate or truncate at the base; petals white. ..... o.

o. Sepals pilose; pedicels pilose. .. p.

p. Pedicels erect in fruit; peduncles pilose with capitate hairs. ..... 11. *T. kruseana.*

p. Pedicels reflexed in fruit; peduncles glabrous except for 1-2 lines of uniseriate hairs. ..... 17. *T. saxicola.*

o. Sepals nearly glabrous, with a few hairs at the point of union of adjacent sepals; pedicels glabrous, reflexed in fruit; peduncles glabrous except for 1-2 lines of uniseriate hairs. ..... 14. *T. neglecta.*

n. Lamina of leaf oblique at the base, rarely cuneate or rounded and then the petals bright pink; seeds trigonal, never lobed. ..... q.

q. Leaves subpetiolate at the base of the plant, to 4.4 cm long, to 1.85 cm wide; sepal midvein pilose; plants annual; seeds reticulate-foveate; bracts at the base of each pedicel with erose margin. ..... 20. *T. warmingiana.*

q. Leaves never subpetiolate, to 14.5 cm long, to 3.5 cm wide; plants perennial; sepals glabrous to pilose, the midvein not distinctively vestite; seeds ribbed, reticulate-

foveate, or reticulate; bracts various. ..... r.
r. Style nearly as long as the ovary, 0.6-1.1 mm long; testa of seeds ribbed areolate-foveate; sepals 4.5-7.0 mm long. ..... 6. *T. diuretica.*
r. Style much shorter than the ovary, 0.15-0.6 mm long; testa of seeds reticulate or reticulate-foveate, never ribbed; sepals 1.8-6.0 mm long. ..... s.
s. Testa reticulate-foveate; peduncles pilose (rarely glabrous or with 2 lines of hairs); ovary 0.5-1.0 mm long; sepals 1.8-4.0 mm long; outer anthers 0.3-0.6 mm long. . 13. *T. multiflora.*
s. Testa reticulate; peduncles glabrous or with 1-2 lines of hairs, rarely pilose, if pilose then ovary 1.2-1.7 mm long; sepals 4.0-6.0 mm long and outer anthers 0.8-1.8 mm long. ..... t.
t. Seed surface uniformly brown; sepals narrowly ovate, elliptical, or obovate, 4.0-6.0 mm long, 1.6-2.8 mm wide; peduncles 0.7-12.7 cm long; inner filaments 4.5-7.5 mm long, densely bearded; petals bright pink or magenta, 5.5-11.0 mm long; ovary 1.2-1.7 mm long; style 0.2-0.6 mm long. .. 12. *T. montana.*

t. Seed surface gray or brownish with lighter reticulations; sepals ovate, 2.5-4.6 mm long, 1.3-2.7 mm wide; peduncles 0.4-5.1 cm long; inner filaments 2.7-4.5 mm long, variously bearded; petals white or pink, 3.5-6.2 mm long; ovary 0.6-1.3 mm long; style 0.1-0.3 mm long. . . . . 18. *T. serrulata.*

1. **Tripogandra amplexans** Handlos, *sp. nov.* HOLOTYPE: **México.** MICHOACAN: Km. 201.2 of Hwy. 15, 8.1 km. north of Tuxpan, 1920 m., 18 Sept. 1967, *Handlos* 428 (US!).

*Herba* annua; *caulis* erectus, usque ad 58.5 cm altus, internodiis infra folia amplexicaulia usque ad 10.5 cm longis. *Folia* ovata, laminis usque ad 7.8 cm longis, usque ad 3.4 cm latis, inferis basi cuneatis, superis amplexicaulis, glabris, margine ciliatis, apice acutis, vaginis usque ad 10.5 mm longis, usque ad 7.7 mm diam., glabris vel linea unica pilorum instructis. *Inflorescentiae* simplices vel paniculatae ex 1-8 cincinnis duplicibus constantes, 1-5 foliis amplexicaulibus et 0-4 bracteis vaginantibus subtentae; *pedunculi* usque ad 6.8 cm longi, glabri vel pilis paucis dispersis, distalibus, capitatis instructi; *cincinni* duplices alabastra, flores, vel fructus usque ad 12 gerentes; *pedicelli* usque ad 7.0 mm longi, pilis capitatis pilosi, erecti vel maturitate effusi, bracteis basi pedicellorum margine integris, glabris vel pilis paucis, dispersis, capitatis pubescentibus. *Flores* albi vel subrosei; *sepala* ovato- vel elliptico-cymbiformia, 2.5-5.0 mm longa, 1.2-2.2 mm lata, pilis paucis, dispersis, capitatis, incoloribus instructa, margine integra et hyalina, apice acuta, rotundata vel obtusa;

*petala* late ovata vel ovato-elliptica, 4.2-8.0 mm longa, 3.9-6.5 mm lata, apice acuminata, acuta, vel obtusa; *stamina* 3, sepalis opposita (Fig. 25), filamentibus 1.0-2.2 mm longis, albis, dorsaliter medio 0-7 pilis albis, incoloribus vel subroseis, moniliformibus pubescentibus (Fig. 6), antheris 0.3-1.0 mm longis, 0.3-1.0 mm latis, albis, polline albido; *staminodia* 3, petalis opposita (Fig. 25), filamentibus epipetalis, 2.0-6.0 mm longis, albis, glabris, sigmoideis et distaliter dilatis (Fig. 26), antheris luteis, 0.2-1.0 mm longis, 0.3-1.0 mm latis, connectivo C- vel V-formi, polline luteo; *ovarium* 0.8-1.5 mm longum, 0.7-1.2 mm diam., glabrum, stylo 0.3-0.8 mm longo, stigmate simplici vel capitellato. *Capsula* globosa, 2.7-3.5 mm longa, glabra, seminibus triangularibus raro trapezoideis (Figs. 58, 59), 1.2-1.8 mm longis, costatis, areolatis, hilo lineari (Fig. 60).

Chromosome number: $n=16$.

Distribution and habitat: western México in the states of Jalisco, Michoacán, México, Morelos, and Guerrero; in damp, rocky places in nearly neutral soil at elevations from 800-2200 m.

Flowering: This species begins flowering in the rainy season from early August and continues until October. Flowers open from 8:00 AM to 9:00 AM and close between 10:30 AM and 12:50 PM. In the field these annuals exhibit a great deal of variation with regard to size when flowering. This is probably due to the amount of moisture available after germination, the effects of grazing, and the fertility of the soil.

REPRESENTATIVE SPECIMENS

**México.** JALISCO: barranca SE of Ciudad Guzman, 22 Oct. 1940, *Moore, Jr.* 158 (BH, GH). MICHOACÁN: Zitácuaro, Dist. Zitácuaro, 1950 m., 6 Sept. 1938, *Hinton et al.* 13198 (ARIZ, GH, MICH, MO, NY, US). MEXICO: just N of bridge, Puente Calderón, ca. km. 135 of Hwy. 55, just north of Ixtapan de la Sal, 6 Aug. 1967, *Handlos* 312 (BH). MORELOS: railroad from Mexico City to Cuernavaca at km. 96; region of El Parque, ca. 2200 m., 5 Oct. 1958, *Hawkes, Hjerting & Lester* 1623 (C, F). GUERRERO: Manchon, Dist. Mina, 1290 m., 13 Aug. 1936, *Hinton et al.* 9206 (ARIZ, GH, NY, US).

The range of *Tripogandra amplexans* is of special interest because it is wholly within the range of the more widespread and similar *T. amplexicaulis*. In many locations the two species occur together. I am unable to discern any differences in habitat preferences for these two species.

The main reasons for considering these plants as two distinct species, aside from morphological differences, are their occurrence together with little evidence of hybridization and the presence of a partial isolating mechanism in the slightly different flowering seasons.

A list of distinguishing characteristics is presented here to summarize the differences between the species. *Tripogandra amplexans* is generally smaller in stature (to 58.5 cm tall), has smaller leaves (to 7.8 cm long, to 3.4 cm wide) which are rounded or cuneate at the base, a smaller inflorescence composed of fewer (to 8) double cincinni, a glabrous peduncle, flowering period from August to October, fewer flowers (to 12 per double cincinnus), which have smaller white or pale pink petals (to 8.0 mm long), seeds with larger, smoother ribs, a deeply impressed embryotega and a flatter dorsal surface.

*Tripogandra amplexicaulis* can be recognized by its taller stature (to 92 cm tall), its larger leaves (to 14.8 cm long, 5.0 cm wide), a narrowed, subpetiolate laminar base in some populations, a large paniculate inflorescence composed of up to 14 double cincinni, a pilose peduncle, flowering period from mid-August to December, more flowers per inflorescence (to 18), larger petals (to 13.0 mm long), flowers bright pink, seeds with an alveolate surface, finer ribs, a slightly impressed embryotega and convex dorsal surface.

There may be evidence of hybridization between these two species because at Puente Calderón in the state of México I found one plant that was vegetatively like *Tripogandra amplexans* with small flowers but showing the bright pink color of *T. amplexicaulis*. Other genetic

mechanisms could explain the flower color difference but for the moment the problem has not been resolved.

A few plants have been collected which exhibit characteristics of both species and can only arbitrarily be placed in either species (Figs. 29, 62, 63). Of these intermediate collections, five are from the known margins of the range, while one collected from a road cut on a steep hillside and another from a lava field represent populations existing in disturbed habitats. Further investigations should be conducted to determine whether these plants represent stabilized hybrids, populations with introgression into one or the other of the parental species, specialized peripheral populations, or whether some other explanation of their intermediacy is plausible. A list of the collections which appear intermediate follows.

SPECIMENS EXAMINED

**México.** JALISCO: ca. km. 781.2 of Hwy. 15, Guadalajara to Tepic, ca. 25 km. NW of Magdalena, 1000 m., 6 Oct. 1967, *Handlos* 451 (BH); km. 1050 of Hwy. 80, 14 km. SW of Autlán, 1120 m., 4 Oct. 1967, *Handlos* 442 (BH). MEXICO: Rincón del Carmen, Dist. Temascaltepec, 1340 m., 16 Sept. 1932, *Hinton* 1745 (BM). MORELOS: lava fields near Yautepec ('Yantepec'), 4500 ft., 22 Oct. 1902, *Pringle* 8697 (BM, C, F, GH, GOET, M, MEXU, MO, MSC, NY, PH, POM, UC, US). GUERRERO: Rincón Viejo, 800 m., 17 Oct. 1963, *Kruse* 898 (MEXU); Hwy. 95 between Ocotito and Tierra Colorado, 680 m., 21 Sept. 1967, *Handlos* 434 (BH); Parotas, Dist. Mina, 800 m., 12 Sept. 1936, *Hinton et al.* 9504 (ARIZ).

2. **Tripogandra amplexicaulis** (Klotzsch ex Clarke) Woodson, Ann. Missouri Bot. Gard. 29:152. 1942.

*Tradescantia amplexicaulis* Klotzsch ex Clarke in DC., Monographiae Phanerogamarum 3:304. 1881. TYPE: **México.** Chiapas, etc. Sept. 1864-70. *Ghiesbreght* 887 (Lectotype, K; isolectotype, GH!).

*Tradescantia dilatata* Clarke in DC., Monographiae Phanerogamarum 3:304. 1881, *nom. nud. pro syn.*

*Tradescantia umbellata* Pavon ex Clarke in DC., Monographiae Phanerogamarum 3:304. 1881, *nom. nud. pro syn.*

*Descantaria amplexicaulis* (Klotzsch ex Clarke) Brückner, Notizbl. Bot. Gart. Berlin-Dahlem 10:56. 1927.

Plants annual; stem erect, to 92 cm tall, unbranched or branching profusely at the base, occasionally decumbent basally and rooting at the nodes; internodes below the inflorescence to 11.2 cm long, glabrous in the upper part of the plant or with a complete or partial line of uniseriate hairs extending down the stem from the sheath above on the side opposite the blade. Leaves narrowly ovate to ovate; blades to 14.8 cm long, to 5.0 cm wide, glabrous on both sides, base of variable shape, always amplexicaul below the inflorescence, at the base of the plant either cuneate, rounded, or narrowed and then appearing petiolate, margin ciliate, apex acuminate, or less often, acute; sheaths to 16.5 mm long, to 11.2 mm in diam., upper ones completely glabrous, lower ones with a few long uniseriate hairs at the orifice, and a complete or partial line of uniseriate hairs extending down the side opposite the blade. Inflorescences terminating each stem, composed of a single double cincinnus or paniculate with up to 14 double cincinni, 1-6 amplexicaul leaves and 0-4 sheathing bracts, cincinni borne terminally and in the axils of the upper bracts and amplexicaul leaves; peduncles to 9.1 cm long, green and/or red, pilose distally, or rarely with only a few scattered capitate hairs with the lowest cell enlarged; double cincinni with up to 13 (-18) buds, flowers and/or fruits; pedicels 3.0-7.3 mm long, to 1.0 mm in diam., erect or spreading in fruit, green or red with a green base, pilose, hairs capitate; bracts at the base of each pedicel pilose or with scattered capitate hairs, margin entire. Flowers bright pink; sepals ovate-cymbiform, 4.0-6.1 mm long, 1.5-3.0 mm wide, green with a darker tip and midvein, or green with a red base and margin, or red, with scattered capitate hairs, margin entire and hyaline, apex more or less acute; petals ovate to broadly ovate, 6.0-13.0 mm long, ca. 3.4-11.5 mm wide, base cuneate, apex acuminate or rounded; stamens 3, opposite the sepals, filaments 1.1-2.0

mm long, pink, bearing a few (5-10) pink, moniliform hairs in two rows in the middle of the dorsal side (Fig. 7), anthers 0.8-1.8 mm long, 0.5-1.8 mm wide, whitish with a pink or magenta line around the more or less parallel anther sacs, dorsifixed, versatile, pollen whitish; staminodes 3, opposite the petals, filaments 3.5-8.0 mm long, slightly epipetalous, pink proximally, white distally, glabrous, inflated in the distal third just below the anthers (Fig. 23), bent in an S-shape; anthers 0.7-2.2 mm long, 0.7-2.2 mm wide, dorsifixed, connective yellow, V-shaped, with yellow, elongate more or less parallel anther sacs, pollen sterile, yellow; ovary 0.6-1.4 mm long, 0.7-1.3 mm in diam., white, glabrous, style 0.3-0.7 mm long, stigma simple or capitellate. Capsule 3.1-4.5 mm long, 2.5-4.0 mm in diam., green or brown, glabrous; seeds 2 per locule, triangular, 1.4-2.2 mm long, dark brown or black, testa areolate, sometimes alveolate (Figs. 64, 65), with ribs radiating from the embryotega (Fig. 66), hilum linear (Figs. 65, 67).

Chromosome number: $n=16$.

Distribution and habitat: Sonora to Chiapas, México and Guatemala; at elevations from (300-) 600 to 2150 m in thin layers of slightly acid soils which range from clay to sandy loam, or humus.

Flowering: Flowering in the native habitat occurs from mid-August through December; most flowering collections seem to have been made in September and October. In México and Ithaca, N.Y., flowers open before 8:00 AM and close between 11:30 AM and 12:50 PM.

REPRESENTATIVE SPECIMENS

**México.** SONORA: Sierra Charuco, Río Mayo, 10 Sept. 1935, *Gentry* 1706 (ARIZ, F, GH, MO, UC, US). CHIHUAHUA: Guayanopa Canyon, Sierra Madre Mts., 23 Sept. 1903, *Jones* (POM). SINALOA: 16.3 miles S.W. of El Paraíso, on road between Villa Unión and El Salto, 27 Sept. 1953, *Ownbey & Ownbey* 1903 (F, MICH, NY, UC, US). DURANGO: La Bajada, Tamazula, 300-600 m., Nov. 1921, *Ortega* 4349 (US). NAYARIT: hills back of Jalisco, 11 Nov. 1925, *Ferris* 5981 (DS). JALISCO: km. 69 of Hwy. 41, N of Guadalajara, 5 Oct. 1967, *Handlos* 448 (BH). MICHOACAN: 11 miles below Uruapan, kms. 95-

96, on road to Apatzingán, 1160 m., 11 Sept. 1961, *Moore, Jr. & Bunting* 8750 (BH, MEXU, UC). MEXICO: Rincón del Carmen, Dist. Temascaltepec, 2 Dec. 1935, *Hinton et al.* 8762 (ARIZ, GH, MICH, NY, US). MORELOS: km. 125.3 of Hwy. 95D, 6.2 km. west of bridge over Río Amacuzac, ca. 1200 m.. 21 Sept. 1967, *Handlos* 431 (BH). PUEBLA: Barranca de Chochonotla, Municipio de la Unión, 4 km. al E. de Xicotepec de Juárez, 27 Sept. 1964, *González Quintero* 1674 (MICH, MSC). GUERRERO: Cañon del Mano, railroad tracks north of Iguala, ca. 3 km. N of El Naranjo, ca. 840 m., 13 Sept. 1967, *Handlos* 417 (BH). CHIAPAS: along Hwy. 190 in the Zinacantán paraje of Muctajoc, Municipio of Ixtapa, 3500 ft., 26 Oct. 1965, *Breedlove* 13797 (DS, F, MEXU). **Guatemala.** HUEHUETENANGO: along road between San Sebastián H. and San Rafael Pétzal, 1900-2000 m., 14 Aug. 1942, *Steyermark* 50537 (F). GUATEMALA: 1939, *Aguilar* 374 (F). JALAPA: mountains about Chahuite, northwest of Jalapa, about 1650 m., 16 Nov. 1940, *Standley* 77472 (F). SANTA ROSA: Cenaguilla, 4000 ft., Dec. 1892, *Heyde & Lux* 4284 (GH, M, NY, US). JUTIAPA: hills between Jutiapa and Plan de Urrutia, north of Jutiapa, 900-1200 m., 28 Oct. 1940, *Standley* 75525 (F).

The history of the name *Tripogandra amplexicaulis* and the specimens associated with it must be considered to understand its present application. In the original description, Clarke (1881) credits Klotzsch for the name *Tradescantia amplexicaulis* in the following fashion, "(Klotzsch ms. in herb. Berol.)". As the Berlin herbarium was largely destroyed during World War II it is not possible to examine the specimens that Klotzsch may have seen. However, type specimens of the Commelinaceae in the basement of the Berlin herbarium did not burn (Pilger, 1957) and among them is a specimen labelled "typus!" collected by C. Ehrenberg in "Mejico" and annotated as *Tradescantia amplexicaulis* by C. B. Clarke in his own hand. This may be the specimen Klotzsch would have designated as the type for his name. Klotzsch never published his description so this specimen has no standing under the current rules. Clarke does not mention the specimen in his description of the species. The Ehrenberg specimen represents *Tripogandra amplexans*. Clarke listed eight collections of *Tradescantia amplexicaulis* (*Schaffner* 108, 138; *Botteri* 531, 892; *Ghiesbreght* 887; *Salvin; Savage; Hoffman*) which are syntypes because no holo-

type was designated. Additionally he cited *Tradescantia umbellata* Pavon as a synonym and I have seen one specimen so labelled from the British Museum and annotated by Clarke as *T. dilatata*, his manuscript name for *T. amplexicaulis*.

The Pavon specimen (*T. umbellata*), *Schaffner* 108, and *Botteri* 531 represent *Tripogandra purpurascens*. *Botteri* 892 and *Ghiesbreght* 887 represent the taxon presently under consideration and the remaining specimens have not been seen. The original description given by Clarke does not overwhelmingly refer to any one species. To preserve current usage of the name *T. amplexicaulis* I therefore designate *Ghiesbreght* 887 (K) as the lectotype for *T. amplexicaulis*. The following phrases from Clarke's description are taken as referring to *T. amplexicaulis* sensu stricto and distinguishing it from *T. purpurascens*. "Pedunculis quasi paniculam efformantibus, . . . Folia . . . acuminata, . . . vaginae ore glabratae; folia summa fere ad vaginas reducta. . . . fructus tempore patenti-erecta." The remainder of Clarke's original description could apply to both species. I do not understand his statement, "Ovarium apice vix aut minute pubescens." I have never seen hairs on the ovary of any specimens of *Tripogandra*.

In the past *Tripogandra amplexicaulis* and *T. amplexans* have been considered the same species. I prefer to separate them on the basis of a number of morphological characters, a difference in flowering season and the fact that I have found both species growing side by side with little or no evidence of hybridization as discussed under *T. amplexans*.

3. **Tripogandra angustifolia** (Robinson) Woodson, Ann. Missouri Bot. Gard. 29:152. 1942.

*Tradescantia angustifolia* Robinson, Proc. Amer. Acad. Arts 27:185. 1893. TYPE: **México.** SAN LUIS POTOSI: Las Canoas, 14 Aug. 1891, *Pringle* 3902. (Holotype, GH!; isotypes. B!, BM!, BR!, E!, GOET!, M!, MO!, MSC!, NY!, PH!, UC!).

*Descantaria angustifolia* (Robinson) Brückner, Notizbl. Bot. Gart. Berlin-Dahlem 10:56. 1927.

Ilustrations: Matuda, Anales Inst. Biol. Nac. México 26:368. 1956 ('1955').

Plants annual; stem erect, to 24 cm tall, unbranched or branched; internodes to 5.0 cm long, green or red, glabrous except for a line of uniseriate hairs extending straight down the side opposite the leaf blade from the sheath above. Leaves linear; blades to 7.1 cm long, 2.7 mm wide, terete or C-shaped in cross section, glabrous dorsally and ventrally, margin usually ciliate in the proximal portion or occasionally to the tip, acute at the apex; sheaths to 4.1 mm long, to 4.0 mm in diam., with a few long uniseriate hairs at the orifice, otherwise glabrous except for a line of uniseriate hairs extending down the side opposite the lamina. Inflorescences composed of 1-4 double cincinni borne terminally and in the axils of the upper leaves; peduncles to 7.5 cm long, green or red, glabrous or sometimes with 1-2 lines of uniseriate hairs extending down one side; buds, flowers and/or fruits 2-10 per double cincinnus; pedicels to 8.0 mm long, to 0.6 mm in diam. at anthesis, green or red, glabrous, erect in fruit; bracts at the base of each pedicel glabrous, margin entire, erose, or sometimes ciliate, lowest 1-2 bracts sometimes leaf-like. Flowers pink, occasionally white; sepals elliptic- or ovate-cymbiform, to 4.5 mm long, to 2.0 mm wide, green, green with a darker tip, or red, glabrous, margin entire, hyaline, apex acute; petals broadly ovate, to 5.0 mm long, to 4.0 mm wide, cuneate basally, apex acute; stamens 3, opposite the sepals, filaments to 1.5 mm long, white or pink, nearly glabrous except for a few minute hairs, anthers 0.3-0.8 mm long, 0.4-0.7 mm wide, pink, connective bent in the middle and U-shaped with the anther sacs parallel (Fig. 14), pollen white; staminodes 3, opposite the petals, filaments epipetalous, to 4.0 mm long, pink and/or white, glabrous, bent in an S-shape distally (Fig. 30), anthers 0.7-1.1 mm long, 0.7-1.1 mm wide, versatile, connective yellow, promi-

nent, C-, U- or V-shaped, with the yellow anther sacs divergent (Fig. 27), pollen white, cream, or yellow, sterile; ovary 0.5-1.0 mm long, 0.4-1.0 mm in diam., green, glabrous, style 0.3-0.7 mm long, stigma simple or capitellate. Capsule globose, 2.0-3.0 mm long, 1.5-2.4 mm in diam., brown, glabrous; seeds 2 per locule, triangular, 0.9-1.3 mm long, brown or gray, testa ribbed farinose (Fig. 74), hilum punctiform (Fig. 75), embryotega impressed.

Chromosome number: $n=8$.

Distribution and habitat: central and southern México and western Guatemala from the states of San Luis Potosí, west to Guerrero and south to Chiapas in México and the department of Huehuetenango in Guatemala; in thin alkaline soil on limestone cliffs and ledges.

Flowering: In the native habitat, flowering occurs in August through October. In a uniform environment, plants collected at different locations flower at different times, probably indicating physiological variation in response to differing environmental factors in the various localities. Flowers open between 7:00 AM and 8:15 AM — earlier in sunny locations and later in shady locations. Closing occurs between 11:00 and 11:30 AM.

REPRESENTATIVE SPECIMENS

**México.** SAN LUIS POTOSI: Pozo de Azuña, 15 km. al E. de Guadalacázar, 1450 m., 26 Sept. 1955, *Rzedowski* 6695 (MEXU, MICH). HIDALGO: between Jacala and Barranca Seca via Hilo Juanico, Dist. Jacala, 1400-1600 m., 30 Oct. 1946, *Moore, Jr.* 1800 (BH, GH). VERACRUZ: Baños del Carrizal, Aug. 1912, *Purpus* 6174 (F, GH, MO, NY, UC, US). MEXICO: rounded hill with crater in the center about 0.5 km. N. of village of Tonatico, 23 Aug. 1965, *Handlos* 169 (BH). MORELOS: near Yautepec, Aug. 1903, *Rose & Painter* 6575 (GH). PUEBLA: km. 298.3 of Hwy. 190, ca. 12.8 km. south of Acatlán, 1340 m., 11 Sept. 1967, *Handlos* 406 (BH). GUERRERO: km. 231.6-7 of Hwy. 95, 37.7 km. north of Chilpancingo, 30 Aug. 1967, *Handlos* 388 (BH). OAXACA: Cerro de San Antonio de la Cal, 1700 m., 18 Aug. 1907, *Conzatti* 1995 (F, MICH). CHIAPAS: km. 1062.5 of Hwy. 190, 4 km. south of Berriozabal, 930 m., 18 Aug. 1967, *Handlos* 364 (BH).
**Guatemala.** HUEHUETENANGO: dry slopes between San Ildefonso Ixtahuacán and Cuilco, 1350-1600 m., 16 Aug. 1942, *Steyermark* 50694 (F, MO, US).

*Tripogandra angustifolia* is unique for its narrow leaves which are nearly terete or C-shaped in cross-section. These leaves are probably a special adaptation which allows the plants to store water between rains and grow in very dry areas. Small plants can survive and produce seeds with as few as three or four leaves and two to four flowers in a single terminal inflorescense. To illustrate how densely plants of *T. angustifolia* grow, in 1967 I arbitrarily selected an area of 100 square cm, ten cm to a side. I carefully removed each plant and discovered there were exactly 240 plants in that area! Each plant was surviving on an average of 0.416 square cm of space.

This species seems to be the only one possessing very short hairs on the staminal filaments. These obscure hairs may indicate that the ancestor of *Tripogandra angustifolia* had a bearded filament and that as an adaptation for water conservation these structures were reduced but not completely lost.

The seeds of *Tripogandra angustifolia* are distinctive for their triangular outline and the conspicuously ribbed sides. Maintenance of this species in cultivation has proved a problem because seed germination has been very low. Field-collected seeds have produced one or two or no seedlings at all where seeds nearly covered the surface of a pot of soil. This contrasts with conditions in México where plants grow in very dense stands, implying a high percentage of seed germination.

*Tripogandra angustifolia* is morphologically very uniform throughout its range which extends for some 1270 km from north to south. The variations which occur — white or pink flowers, red or green stems or leaves — occur within a population and do not distinguish one population from another. One or two leaf-like bracts occur rarely at the base of an inflorescence and may indicate an ancestral inflorescence similar to that of present day *Tradescantia* which has large leaf-like bracts. There are slight variations in intensity of flower color and petal shape in plants

from different populations, but the significance of these variations is unknown. The general lack of morphological variation may be due to the specialized and uniform habitat which this species inhabits — the thin layer of alkaline soil found in cracks or on ledges of limestone rock throughout southern México and parts of Guatemala — where it seems to be specially adapted to survive. As soil depth increases, other species of plants seem to be better adapted to compete and *T. angustifolia* is crowded out.

4. **Tripogandra brasiliensis** Handlos, *sp. nov.* HOLOTYPE: **Brazil.** MARANHAO: "Ilha de Balsas" region, between the Balsas and Parnaíba Rivers. Ca. 6 km. north of main house of Fazenda "Morros", ca. 30 km. south of Lorêto, ca. 300 m., 30 April 1962, *Eiten & Eiten* 4458 (NY!).

*Herba* annua(?); *caulis* erectus, usque ad 52.5 cm altus, internodiis usque ad 13.4 cm longis, linea unica pilorum instructis, aliter glabris vel pilis dispersis pubescentibus. *Folia* angusto-ovata, petiolata, laminis usque ad 8.7 cm longis, usque ad 2.1 cm latis, apice acuminatis, basi obliquis, margine ciliatis, dorsaliter pilosis vel pilis dispersis instructis, ventraliter glabris praeter lineam unicam pilorum secus costam, vaginis usque ad 6.0 mm longis, usque ad 3.6 mm diam., orificio villosis, linea unica pilorum instructis, aliter glabris vel pilis dispersis praeditis. *Inflorescentiae* terminales et in axillis foliorum summorum, ex 1-2 cincinnis duplicibus constantantes; *pedunculi* usque ad 3.9 cm longi, pilis paucis dispersis pubescentes; *pedicelli* usque ad 3.0 mm longi, glabri, bracteis basi pedicellorum glabris, margine integris. *Flores* albi; *sepala* ovato-cymbiformia, usque ad 4.2 mm longa, usque ad 2.7 mm lata, glabra vel 1-2 pilis instructa, margine hyalina, apice obtusa; *petala* non visa; *stamina* 6 in verticillis duobus, 3 sepalis opposita filamentibus brevis, usque ad 1.5 mm longis, glabris, antheris usque ad 0.7 mm longis, usque ad 0.6 mm latis, 3 petalis opposita filamentibus longioribus, usque ad 3.9 mm longis, dilatatis et barbatis distaliter,

antheris usque ad 0.4 mm longis, usque ad 0.9 mm latis, connectivo elongato; *ovarium* usque ad 1.5 mm longum, usque ad 1.0 mm diam., glabrum, stylo usque ad 0.3 mm longo, stigmate simplici. *Capsula* globosa, usque ad 3.2 mm longa, usque ad 3.3 mm diam., glabra, seminibus triangularibus, usque ad 2.0 mm longis, costatis, areolatis (Fig. 47), hilo elliptico (Fig. 48).

Vernacular name: baixão do cipó, fide Eiten & Eiten.

Distribution: known from only three locations in Maranhão and Minas Gerais, Brazil. The habitat of this species, according to Eiten and Eiten, was tall forest along a gully in a disturbed area with a pronounced dry season and intermittent streams.

SPECIMENS EXAMINED

**Brazil.** MARANHAO: 30 April 1962, *Eiten & Eiten* 4458 (NY). MINAS GERAIS: Lagoa Santa, *Warming* (F p.p., US p.p.); Lagoa Grande, Belo Horizonte, Mar. 1935, *Cocheau* (R).

This species is recognizable from its probable annual habit, petiolate leaves, peduncle with scattered uniseriate hairs, an inflated filament on the longer stamens, and the large ribbed areolate seeds with elliptical hilum. While the collections known to me are few, the species is undoubtedly distinct from other South American species of *Tripogandra*.

5. **Tripogandra disgrega** (Kunth) Woodson, Ann. Missouri Bot. Gard. 29:152. 1942.

   *Tradescantia disgrega* Kunth, Enumeratio Plantarum 4:97. 1843. TYPE: **México.** Serro Colorado, Aug. 1828, *Schiede* 974 (816) (Lectotype, B!; isolectotype, HAL!).

   *Tradescantia ehrenbergiana* Klotzsch ex Clarke in DC., Monographiae Phanerogamarum 3:305. 1881, *nom. nud. pro syn.*

   *Disgrega mexicana* Hasskarl ex Clarke in DC., Monographiae Phanerogamarum 3:305. 1881, *nom. nud. pro syn.*

*Descantaria disgrega* (Kunth) Brückner, Notizbl. Bot. Gart. Berlin-Dahlem 10:57. 1927.

*Tradescantia disgrega* forma *glandulosa* Standley & Steyermark, Field Mus. Nat. Hist., Bot. Ser. 23:36. 1944. HOLOTYPE: **Guatemala.** ZACAPA: Sierra de las Minas, along trail between Río Hondo and summit of mountain at Finca Alejandria, 1000-1500 m., 11 Oct. 1939, *Steyermark* 29751 (F!); photograph (F!).

*Tradescantia disgrega* forma *pubescens* Standley & Steyermark, Field Mus. Nat. Hist., Bot. Ser. 23:37. 1944. HOLOTYPE: **Guatemala.** GUATEMALA: Borraja, 1085 m., Oct. 1928, *Morales R.* 1106 (F!); photograph (F!).

*Tripogandra disgrega* forma *glandulosa* (Standley & Steyermark) Standley & Steyermark, Fieldiana: Bot. 24(3):37. 1952.

*Tripogandra disgrega* forma *pubescens* (Standley & Steyermark) Standley & Steyermark, Fieldiana: Bot. 24(3):37. 1952.

Plants annual, rooting at lower nodes; stem erect, to 55 cm tall, branched or unbranched, some plants with the lowermost portion decumbent; internodes to 12.5 cm long, pilose or glabrous except for a line of uniseriate hairs extending down the side of the stem, continuous with the line on the sheath above. Leaves narrowly ovate to ovate; blades to 9.8 cm long, 3.8 cm wide, cuneate, rounded, or subpetiolate at the base, glabrous to pilose on both sides, the uppermost leaf usually with fewer or no hairs, margin ciliate, apex acute or acuminate; sheaths to 15.0 mm long, 4.3 mm in diam., villous at the orifice, a line of uniseriate hairs extending down the side opposite the blade, otherwise glabrous to pilose. Inflorescences composed of 1-5 double cincinni borne terminally and in the axils of the upper leaves; peduncles to 9.5 (-15) cm long, glabrous or with a few capitate hairs near the distal end; double cincinni with up to 25 buds, flowers and/or fruits; pedicels to 7.0 mm long, glabrous proximally but pilose distally,

reflexed in fruit; bracts at the base of each pedicel pilose or with scattered capitate hairs, margin entire. Flowers pink; sepals ovate- or elliptic-cymbiform, to 6.0 mm long, 3.0 mm wide, green or with red at the tip and/or base, pilose or with scattered capitate hairs 1.5-4.5 mm long, margin hyaline, apex more or less acute; petals broadly ovate, to 8.0 mm long, to 7.0 mm wide, base cuneate, apex acuminate; stamens 6, in two whorls, the outer shorter, filaments to 2.0 mm long with a few (ca. 10) moniliform hairs borne on the middle of the dorsal side, anthers 0.7-1.6 mm long, 0.5-1.4 mm wide, dorsifixed, versatile, with anther sacs slightly spreading (not parallel); stamens of the inner whorl longer, filaments to 8.0 mm long, glabrous, with a U- or open S-shaped bend and inflated in the upper half, anthers to 1.5 mm long, to 1.6 mm wide, basifixed, connective conspicuous, anther sacs either divergent or becoming parallel and adjacent through bending of the connective in a U-shape; ovary to 1.1 mm long, to 1.3 mm in diam., glabrous, style 0.4-0.7 mm long, stigma simple or capitellate (minutely penicilliform). Capsule globose, to 3.5 mm long, to 3.5 mm in diam., green or brown at maturity, glabrous; seeds 2 per locule, triangular or rarely elliptical, 1.2-1.7 mm long, brown to black, testa areolate, with ribs (sometimes obscure) radiating from the embryotega (Fig. 52), hilum punctiform (Fig. 53).

Vernacular name: yerba del pollo fide Hinton.

Distribution and habitat: from Jalisco to Chiapas, México, Guatemala, Honduras and El Salvador; in moist areas along streams or in pine forests, occasionally a weed in cornfields.

Flowering: This species flowers from August to November in different parts of México, and from October to February in Guatemala. The flowers open before 8:45 AM and begin closing about 11:25 AM.

REPRESENTATIVE SPECIMENS

**México.** JALISCO: Sierra del Tigre, 3 miles south of Mazamitla, 2100-2200 m., 22 Sept. 1952, *McVaugh* 13167 (MICH). HIDALGO: vicinity of Molango on Lolotla road, Municipality Molango, District

Molango, 1600 m., 9 Nov. 1946, *Moore, Jr.* 1984 (BH). VERACRUZ: Orizaba, *Botteri* 326 (GH). MICHOACAN: roadsides in pine zone about 48 kms. from Pátzcuaro on road to Tacámbaro, ca. 6-7000 ft., 2 Sept. 1948, *Moore, Jr. & Wood, Jr.* 4847 (BH). MEXICO: Ypericones, Dist. Temascaltepec, 23 Nov. 1935, *Hinton et al.* 8718 (GH, MICH, MO, NY). MORELOS: in pine forest, km. 61, off Cuernavaca-Mexico City Highway, 2 Oct. 1943, *Lundell & Lundell* 12496 (MICH, NY, UC). OAXACA: 15 km. al S. de Sola de Vega, sobre la carretera a Puerto Escondido, 1800 m., 30 Sept. 1965, *Rzedowski* 21296 (MICH). CHIAPAS: sitio in San Cristóbal las Casas, Municipio of San Cristóbal las Casas, 7100 ft., 20 Sept. 1965, *Breedlove* 12310 (DS). **Guatemala.** SAN MARCOS: barrancos 6 miles south and west of town of Tajumulco, northwestern slopes of Volcán Tajumulco, 2300-2800 m., 26 Feb. 1940, *Steyermark* 36621 (F). CHIMALTENANGO: above Las Calderas, 1800-2100 m., 15 Dec. 1938, *Standley* 60014 (F). SACATEPEQUEZ: Ciudad Vieja, Nov. 1914, *Tejada* 301 (US). GUATEMALA: near San Juan Sacatepéquez, about 1800 m., 8 Dec. 1938, *Standley* 59258 (F). SANTA ROSA: Santa Rosa, 3000 ft., Nov. 1892, *Heyde & Lux* 4285 (GH, NY, US). **Honduras.** MORAZAN: colinas cultivadas de maíz de la Montañita, 1500 m., 18 Nov. 1948, *Molina R.* 1610 (GH, US). EL PARAISO: slopes above Yuscarán, Montserrat, 1500 m., 25 Nov. 1958, *Hawkes, Hjerting & Lester* 2061 (C, K). **El Salvador.** SANTA ANA: Hda. Los Planes nördl. Metapán, 1800 m., 29 Oct. 1950, *Rohweder* 707 (F). MORAZAN: eastern edge, finca of General J. T. Calderón, Montes de Cacaguatique, ca. 1340 m., 28 Dec. 1941, *Tucker* 646 (BH p.p., F p.p., MICH p.p., MO, NY p.p., PH p.p., UC p.p., US p.p.).

Schlechtendal (1831) described but did not name a plant of *Tripogandra disgrega* from a specimen (*Schiede* 974 (815)) housed at Halle. Kunth later named the species and his description was drawn from a duplicate specimen of Schiede's housed in Berlin "(Descr. juxta specimen Schiede.)". In all respects the description and specimen are in accord. I have seen two sheets of this collection and because there is no evidence that Kunth saw the sheet at Halle, I designate the Berlin specimen as the lectotype, therefore making Schlechtendal's material at Halle an isolectotype.

Kunth's original description cites another specimen, *Berlandier* 948. There is such a specimen in the Berlin herbarium but it is not annotated by Kunth so perhaps he did not see this particular sheet. This collection is a

specimen of *Tripogandra purpurascens*. These two species are similar and, as the Berlandier specimens are widely distributed, the name *T. disgrega* has been applied consistently to two different species. As Kunth drew his description from the Schiede specimen, no name other than *T. disgrega* can be applied to this species. There seems to be no other course if one believes there are two species but to call this one *T. disgrega* and to apply another name to the species represented by *Berlandier* 948.

*Tripogandra disgrega* has some variable morphological characteristics but I am unable to see any trends or pattern in the variation. The species is rare and has not been collected often. The vesture of the leaves varies considerably but not in any consistent way. The leaves may be glabrous on both sides or may have a varying amount of hair ranging from scattered to pilose. When hairs are found on the leaves they are also present on the internodes and on the leaf sheaths. *Tripogandra disgrega* forma *pubescens* represents the extreme condition in pilosity.

There does seem to be some correlation between the presence of hairs on the leaves and a narrowing at the base of the blade producing a subpetiolate appearance. More of the pilose-leaved plants have a narrowed blade than do the glabrous-leaved plants, but the significance, if any, of this correlation is not evident.

*Tripogandra disgrega* and *T. purpurascens* are very similar in most respects and on this basis I would consider them very closely related. One difference separates all specimens and a second difference separates most. *Tripogandra disgrega* has long hairs on the sepals, the longest from 1.5-4.5 mm long, while the hairs on the sepals of *T. purpurascens* are shorter and vary from 0.2-1.0 mm long on dried specimens. Most plants of *T. disgrega* have a glabrous peduncle, but in three of 31 collections there were scattered capitate hairs on the distal end. *Tripogandra purpurascens* is more variable, plants may have glabrous peduncles or any single plant may have both

glabrous and variously vestite peduncles, ranging from scattered hairs to pilose and/or with one or two lines of hairs.

The following differences between these species generally hold but there are exceptions which may be due partly to environmental influences, may be due also to genetic effects, or could be the result of undetected hybridization. *Tripogandra disgrega* usually has flat open leaves which may be subpetiolate, the plants grow in shady habitats, the petals are acuminate distally, the dorsal surface of the seeds is rounded or convex, the seeds are often obscurely ribbed, and in any given location the peak of flowering seems to occur later in each season than the peak of flowering for *T. purpurascens*. In contrast, *T. purpurascens* has complicate (folded or canaliculate) leaves which are usually rounded at the base and never narrowed and petiolate, the plants grow in open sunny locations, the petals are irregularly indented or acuminate at the apex, the seeds are prominently ribbed and the dorsal surface is flat or even concave with a deeply impressed embryotega, and flowering seems to occur earlier in each season in a given location than the peak of flowering for *T. disgrega*.

6. **Tripogandra diuretica** (Martius) Handlos, *comb. nov.*

*Tradescantia diuretica* Martius in Spix & Martius, Reise in Brasilien 281. 1823. HOLOTYPE: **Brazil.** Min. Ge. et S. Pauli, *Martius* (M!).

*Tradescantia commelina* Vellozo, Florae Fluminensis 140; 3:154. 1829 (1825). HOLOTYPE: apparently lost.

*Tradescantia diuretica β foliis vaginisque magis glabris* Schultes in Schultes & Schultes, Systema Vegetabilium 7:1163. 1830. HOLOTYPE: **Brazil.** *Martius* (M!).

*Tradescantia gaudichaudiana* Kunth, Enumeratio Plantarum 4:93. 1843. HOLOTYPE: **Brazil.** Rio Janeiro, 1832, *Gaudichaud* 125 (B!).

*Tradescantia mollis* Kunth, Enumeratio Plantarum 4:95. 1843. TYPE: **Brazil.** 1836, *Sello* 565 (Holotype, B!; isotype, B!).

*Tradescantia sellowiana* Kunth, Enumeratio Plantarum 4:93. 1843. TYPE: **Brazil.** Vittoria-Bahia, 1836, *Sello* 1006 (Holotype, B!; isotype, B!).

*Tradescantia diuretica* α *mollis* (Kunth) Seubert in Martius, Flora Brasiliensis 3(1):251. 1855.

*Tradescantia diuretica* β *glabriuscula* Schultes ex Seubert in Martius, Flora Brasiliensis 3(1):251. 1855. HOLOTYPE: **Brazil.** Yrino, *Sello* 1309 (B!).

*Tradescantia elongata* β *diuretica* (Martius) Clarke in DC., Monographiae Phanerogamarum 3:303. 1881.

*Descantaria diuretica* Schlechtendal fide Hasskarl ex Clarke in DC., Monographiae Phanerogamarum 3: 304. 1881, *nom. nud. pro syn.*

*Tripogandra elongata* forma *diuretica* (Martius) Standley & Steyermark, Fieldiana: Bot. 24(3):38. 1952.

Illustrations: Bacigalupo, Darwiniana 14:407, 410. 1967; Figs. 4, 5k, l, as *Tripogandra elongata.*

Plants perennial, the base decumbent, rooting at the nodes; stems to 11.5 dm long, flowering stems erect, rarely branched; internodes to 12.1 cm long, with a complete or partial line of uniseriate hairs extending down the side from the sheath above, otherwise glabrous or rarely completely pilose or pilose distally. Leaves narrowly ovate to ovate; blades to 14.2 cm long, to 2.6 cm wide, base oblique, rounded on one side, cuneate on the other, dorsal and ventral side glabrous to pilose, midvein with or without a partial or complete line of uniseriate hairs ventrally, margin ciliate; sheaths to 20.0 mm long, to 9.5 mm in diam., villous at the orifice, with a line of uniseriate hairs extending down the side opposite the blade, otherwise glabrous to pilose. Inflorescences of 1-10 double cincinni borne terminally and in the upper 1-4 leaf axils; peduncles to 8.9 cm long, usually glabrous, rarely pilose or with a

few scattered uniseriate hairs; buds, flowers and/or fruits to 17 per double cincinnus; pedicels 3.5-9.0 mm long, glabrous, reflexed in fruit; bracts at the base of each pedicel glabrous or rarely pilose or with a few scattered uniseriate hairs, margin entire, with a few uniseriate hairs, or ciliate. Flowers pink; sepals narrowly ovate to ovate, cymbiform, 4.5-7.0 mm long, 1.4-3.3 mm wide, glabrous or with a few uniseriate hairs at the apex, rarely pilose, margin hyaline, apex acute; petals more or less elliptic, to 10.0 mm long, to 6.5 mm wide, base cuneate, apex acute to rounded; stamens 3, opposite the sepals, filaments 1.2-2.3 mm long, glabrous or with a few (2-3) hairs, anthers 1.0-1.8 mm long, 0.6-1.1 mm wide, basifixed, anther sacs more or less parallel; staminodes 3, opposite the petals, 4.0-6.3 mm long, bearded in the upper third or fourth with moniliform hairs, distal end bent in an S-shape, anthers 0.7-1.4 mm long, 0.8-1.5 mm wide, basifixed, with parallel, yellow anther sacs, pollen sterile; ovary 0.7-1.4 mm long, 0.7-1.0 mm in diam., glabrous, style 0.6-1.1 mm long, stigma simple. Capsule globose or obovoid, 2.8-3.5 mm long, 2.1-3.0 mm in diam., glabrous, brown; seeds 1-2 per locule, triangular, the dorsal side convex, 1.2-1.8 mm long, light gray, testa ribbed, areolate-foveate (Fig. 40), hilum elliptic or punctiform (Fig. 41).

Chromosome number: $2n=64$ (A. Sparrow, pers. comm.).

Vernacular name: trepueraval, jupirava tupice fide Martius; trepoerava fide Peckolt, Brazil.

Distribution and habitat: southern Brazil, Bolivia, Paraguay, Argentina, and Uruguay; commonly in low wet places near sea level to 1600 (-2200) m. This species in Brazil seems adapted to moist swampy locations and is not found in limestone outcrop areas as are many of the species in México (Father Reitz, verb. comm.).

Flowering: Flowering occurs from December to July.

REPRESENTATIVE SPECIMENS

**Bolivia.** LA PAZ: San Bartolomé, near Calisaya, Basin of Río Bopi, province of S. Yungas, 750-900 m., 1-22 July 1939, *Krukoff* 10545

(GH, K). COCHABAMBA: vic. Cochabamba, 1891, *Bang* 1282 (BM, E, F, G, GH, NY, US). **Paraguay.** Mbuveva, Apr. 1931, *Jorgensen* 4355 (US). **Brazil.** PERNAMBUCO: Pesqueira, 20 Jan. 1943, *Vellozo* 561 (R). MATTO GROSSO: *Smith* 818 (R). MINAS GERAIS: Viçosa, road from Canella to Represa, Buraco Canella, 730 m., 7 Jan. 1930, *Mexia* 5487 (BH, BM, F, GH, LA, MICH, MO, NY, PH, UC, US). RIO DE JANEIRO: Theresopolis, na Serra dos Orgãos, Jan. 1955, *Vidal* V-120 (R). FEDERAL DISTRICT: Botanical Garden and vicinity, Nov. 1915, *Curran* 7 (US). SAO PAULO: Parque do Estado de São Paulo, 26 Mar. 1931, *Hoehne* 27392 (B, NY, SP). PARANA: Jaguariahyva, 28 Mar. 1916, *Dusén* 18037 (F, MO, NY, US). SANTA CATARINA: Mina Velha, Garuva, S. Francisco do Sul, 10 m., 26 Mar. 1958, *Reitz & Klein* 6618 (NY, UC, US). RIO GRANDE DO SUL: Torres, Municipio de Torres, Feb. 1939, *Vidal* (R). **Uruguay.** MONTEVIDEO: Miguelete, 10-20 m., May 1925, *Herter* 149 (B, BH, F, GH, M, MICH, MO, MSC, NY, U, UC, WIS). **Argentina.** MISSIONES: Dep. San Pedro, Loc. Avellaneda, 8 Apr. 1949, *Schwindt* 1535 (BR, NY, US). BUENOS AIRES: Partido de Delta, Parayá Mini, 18 May 1950, *Cabrera* 10635 (US).

The plants which I have included in *Tripogandra diuretica* generally have been considered a form of *T. elongata* by taxonomists. The differences in the seeds, flowers, ratio of style length to ovary length, leaf vesture when present, and habitat are of a greater magnitude than those which serve to distinguish forms. Furthermore, I consider *T. elongata* sensu stricto to be composed of sterile material which I include in *T. serrulata*. The problem is further discussed under that species.

Variation in leaf vesture is seen among the collections of *Tripogandra diuretica*, but does not seem to follow any discernible geographic pattern.

Herbarium material of this species is unusual because a high percentage of specimens possesses open, dried flowers. This is related to the fact that flowers on plants growing in the greenhouse remain open all day and are longer lived than those of other species.

7. **Tripogandra encolea** (Diels) Macbride, Revista Univ. (Cuzco) 33(87):142. 1944.

*Tradescantia encolea* Diels in Urban, Bot. Jahr. Syst. 37:381. 1906. TYPE: **Perú.** CAJAMARCA: San Pablo,

2200-2400 m., 1906, *Weberbauer* 3855 (Holotype, B!; isotype, G!).

*Descantaria encolea* (Diels) Brückner, Notizbl. Bot. Gart. Berlin-Dahlem 10:56. 1927.

"*Tripogandra encolea* (Diels) Rohweder", Abh. Auslandsk., Reihe C, Naturwiss. 18:156. 1956.

Plants trailing, decumbent, stems branching and rooting at the nodes; flowering stems upright, to 65 cm tall, 0.1-0.4 cm in diam. when dry, green; internodes 1.5-9.5 cm long, always with a line of uniseriate hairs extending in a line laterally down the internode from the sheath above, otherwise glabrous basally and pilose distally in the erect part of the plant. Leaves narrowly ovate; blade 1.9-7.4 cm long, 0.9-2.6 cm wide, reduced to sheathing bracts near the top of the flowering stem, tapering or cordate at the base on the lower part of the stem, usually amplexicaul at the base below the inflorescence, glabrous ventrally, glabrous dorsally or sometimes pilose near the sheath, hairs uniseriate, margin ciliate, apex acute; sheaths 0.4-2.9 cm long, 0.25-0.9 cm in diam. when dry, villous at the orifice, otherwise glabrous except for a line of uniseriate hairs laterally opposite the leaf blade; sheathing bracts glabrous, pilose, or with scattered capitate hairs. Inflorescences composed of 1-4 double cincinni borne terminally and in the axils of the upper leaves; peduncles 1.0-7.0 cm long, ca. 1 mm in diam. when dried, glabrous or pilose at the base, densely pilose near the apex, hairs capitate, brown or colorless; double cincinni with 7-18 buds, flowers and/or fruits; pedicels of flowers near anthesis 0.3-0.7 cm long, pilose with capitate hairs; bracts at the base of each pedicel glabrous or pilose with capitate hairs. Flowers white or pink; sepals ovate-cymbiform, 4.5-6.2 mm long, 1.5-3.0 mm wide, pilose with brown or colorless capitate hairs, apex obtuse, margin entire; petals obovate, ca. 4-5.8 mm long, ca. 2.5-4.5 mm wide, tapering at the base, apex obtuse; stamens of outer whorl 3, shorter, filaments before anthesis 1.3-2.0 mm long, glabrous, anthers 0.9-1.5 mm long, 0.7-

1.0 mm wide, white, dorsifixed, versatile, with parallel anther sacs; stamens of inner whorl longer, filaments 3.0-3.5 mm long, densely bearded with moniliform hairs in the distal portion, anthers 0.8-1.0 mm long, 0.7-1.1 mm wide, basifixed, versatile, with yellow anther sacs parallel or diverging slightly, longer than the connective; ovary 0.9-2.0 mm long, 0.8-1.2 mm in diam., glabrous, style 0.3-0.7 mm long, stigma simple or capitellate. Capsule brown, glabrous, ca. 3 mm long, 2.5 mm in diam.; seeds 6, triangular, 1.3-1.5 mm long, dark brown; hilum punctiform to elliptical.

Distribution and habitat: Perú to Bolivia; in moist rocky soil.

SPECIMENS EXAMINED

**Perú.** CAJAMARCA: San Pablo, 2200-2400 m., 1906, *Weberbauer* 3855 (B, G). LA LIBERTAD: Sammne-Casmiche, Prov. Otuzco, 1800 m., 21 May 1952, *López M.* 0844 (US). LIMA: San Mateo, Prov. Huarochiri, 3200 m., 24 Mar. 1952, *Hutchison* 815 [grown and collected Univ. of Calif.-Berkeley, 19 Oct. 1957, G.B. Newcomb] (BH, F, G, GH, UC). Matucana, ca. 8000 ft., 12 April-3 May 1922, *Macbride & Featherstone* 350 (G, US); Prov. Cajabomba, Banos de Churin, 9000 ft., 7 Feb. 1946, *Laudemer* 5414 (K). **Bolivia.** COCHABAMBA: Ayopaya, Sailapata, 2700 m., *Cárdenas* 3029a (US). Río de Guinllabamba, 10 June 1876, *Andre* 3608 (K, NY).

Diels' original description of this species reported the length of leaf sheaths to be 3-4 cm, the peduncles to be 1.5-2 cm, and petals to be 8-9 mm. My measurements of the type specimens show leaf sheaths 0.7-2.9 cm long, peduncles 1.0-4.5 cm long, and petals 5.8 mm. If additional information was available to Diels he does not mention that fact.

An examination of all the specimens available of this rather rare species reveals that there are minor morphological differences among them which is not surprising if one considers the limited amount of material available and the ecological diversity of the mountains which this species inhabits.

8. **Tripogandra glandulosa** (Seubert) Rohweder, Abh. Auslandsk., Reihe C, Naturwiss. 18:156. 1956.
*Tradescantia glandulosa* Seubert in Martius, Flora Brasiliensis 3(1):253. 1855. HOLOTYPE: **Brazil.** PARANA: Río Negro, 7 Mar. 1823, *Sello* 995 (B!).
*Tradescantia radiata* Clarke in Chodat & Hassler, Bull. Herb. Boissier 3:245. 1903. HOLOTYPE: **Paraguay.** AMAMBAY: in regione cursus superioris fluminis Apa, Feb. 1901-2, *Hassler* 8493 (G!).
*Tradescantia pflanzii* Brückner, Bot. Jahr. Syst. 61(1): 13. 1927 ('1926'), *nom. nud.*
*Descantaria glandulosa* (Seubert) Brückner, Notizbl. Bot. Gart. Berlin-Dahlem 10:56. 1927.
*Descantaria pflanzii* Brückner, Notizbl. Bot. Gart. Berlin-Dahlem 10:57. 1927. HOLOTYPE: cult. in hort. Berol. (B!).
*Descantaria radiata* (Clarke) Brückner, Notizbl. Bot. Gart. Berlin-Dahlem 10:56. 1927.
*Tripogandra pflanzii* (Brückner) Rohweder, Abh. Auslandsk., Reihe C, Naturwiss. 18:156. 1956.
*Tripogandra radiata* (Clarke) Bacigalupo, Darwiniana 13:90. 1964.

Illustrations: Bacigalupo, Darwiniana 13:92, 93. 1964 (Figs. 1, 2); 14:404, 410. 1967 (Figs. 3, 5).

Plants perennial, rooting at nodes of decumbent stems; flowering stems upright, to 39 cm tall, branching from decumbent stems; internodes to 9.5 cm long, glabrous or with a partial line of uniseriate hairs extending down the stem from the sheath above. Leaves narrowly ovate to ovate; blades to 6.7 cm long, to 2.3 cm wide, glabrous, base cuneate on the lower part of the plant, rounded on the upper portion of the plant, margin ciliate, apex acute; sheaths to 11.0 mm long, to 8.6 mm in diam., a few long hairs at the orifice, a line of uniseriate hairs extending down the side of the sheath opposite the blade, otherwise glabrous. Inflorescences of 1-10 (-23) double cincinni borne terminally and in 1-4 of the upper leaf axils; peduncles

to 3.1 cm long, variously glabrous or with 1-2 lines of uniseriate hairs, or glabrous proximally and pilose distally, hairs capitate; double cincinni with up to 11 buds, flowers and/or fruits; pedicels 2.3-6.0 mm long, recurved in fruit, pilose with capitate hairs; bracts subtending each pedicel glabrous to pilose with capitate hairs, margin denticulate, entire, or ciliate. Flowers white or pink; sepals narrowly ovate, 3.0-4.2 mm long, 1.2-1.9 mm wide, pilose, hairs capitate, margin hyaline, apex acute; petals ca. 3.5-5.0 mm long; stamens 6, in two whorls, the outer shorter, filaments to 1.5 mm long, with moniliform hairs borne on the middorsal portion, anthers 0.6-0.9 mm long, 0.4-0.8 mm wide, basifixed, anther sacs parallel; stamens of the inner whorl longer, filaments to 3.3 mm long, glabrous, ligulate, concave in the upper third of their length, anthers 0.4-1.1 mm long, 0.4-0.7 mm wide, basifixed, anther sacs parallel; ovary 0.5-1.0 mm long, 0.4-0.9 mm in diam., glabrous, style 0.2-0.5 mm long, stigma simple or capitellate. Capsule globose, to 2.7 mm long, to 3.1 mm in diam., glabrous, light brown; seeds 2 per locule, rounded-triangular, 0.8-1.4 mm long, light gray to brown, testa reticulate-foveate with small prominent ribs radiating from the punctiform hilum (Figs. 42, 43).

Chromosome number: $n=8$.

Distribution and habitat: southern Bolivia and Brazil, Paraguay, Uruguay, and northeastern Argentina; in moist places and along streams.

Flowering: Flowering of this species seems to occur between September and March.

REPRESENTATIVE SPECIMENS

**Brazil.** PARANA: Sete Quedas, Mun. Guaira, 11 Dec. 1965, *Hatschbach, Lindeman & Haas* 13339 (US). **Paraguay.** AMAMBAY: zwischen Río Apa und Río Aquidaban, 1908-9, *Fiebrig* 4487 (BM, G, K, L). SAN PEDRO: Alto Paraguay, Primavera, 13 Oct. 1955, *Woolston* 596 (C, NY). GUARIA: Villarrica, Cerro Peladu(?), Dec. 1930, *Jorgensen* 4112 (DS, F, MO, NY, PH, US). **Argentina.** FORMOSA: Colonia Clorinda, 150 m., 30 Dec. 1926, *Venturi* 9163 (US). CATAMARCA: road 38 from Tucumán to Catamarca, Cuesta de Totoral, km. 1384.7, Dept. Paclín, 900 m., 24 Mar. 1966, *Hawkes, Hjerting & Rahn* 3989 (C). TUCUMAN:

El Duraguito, Dept. Capital, 550 m., 14 Jan. 1922, *Venturi* 1672 (F p.p., US, US p.p.). CHACO: Margarita Belén, Dept. Resistencía, 9 Dec. 1945, *Aguilar* 563 (G). SANTA FE: Lonteri, Estancia Bomazzola, 1 Feb. 1936, *Job* 1185 (US). CORRIENTES: Corrientes, 4 Sept. 1959, *Mattson* 3119 [grown in Copenhagen, collected by Pedersen in 1953] (C). ENTRE RIOS: Concepción del Uruguay, 3 Dec. 1877, *Lorentz* (GH). **Uruguay.** RIVERA: Cunapiru, 6-700 ft., 1928, *Wright* (BM). CERRO LARGO: Río Branco, 5-10 m., 27-29 Nov. 1947, *Herter* 2127 (MO, NY, US). TREINTA Y TRES: Vergara, 20 m., Dec. 1932, *Herter* 1608 (US).

*Tripogandra glandulosa* has very distinctive seeds and this fact was recognized by the authors of the names *Tradescantia glandulosa*, *T. radiata*, *Descantaria pflanzii*. While the seeds are diagnostic, other statements in all of the original descriptions are somewhat misleading. An examination of the type specimens shows all the floral and seed characters to be identical.

The combination *Tripogandra pflanzii* has been published three times. The Gray Herbarium Card Index credits Celarier (1955) with the earliest combination. This combination was not validly published according to Article 33 of the International Code of Botanical Nomenclature (1966). Burkart also combined the epithet in 1959, but this publication was later than Rohweder's (1956) valid publication of the name.

Bacigalupo (1964) was the first person to consider *Tripogandra radiata* and *T. pflanzii* the same species but he does not seem to have seen the type specimen of *T. glandulosa* and recognized its identity.

Several collections of apparently sterile plants have been made in Trinidad [*Broadway* 9145 (BM, UC); *Fendler* 862 (BM, K); *Grisebach* 22 (K)], French Guiana [*Sag.* 948 (BM)], and Pará, Brazil [*Huber* 93 (BM)]. Pollen from an herbarium specimen mounted in aniline blue-lactophenol did not stain and is interpreted as having been sterile and non-functional when fresh. No specimens have seeds though inflorescences are present.

These plants differ in the generally larger leaves (to 7.5 cm long), the presence of one to several lines of hairs on

the sheath, a line of hairs along the midrib on the lower leaf surface, peduncles to 4.4 cm long, and all staminal filaments glabrous. Broadway's collections have small stolon-like branches perforating the leaf sheaths.

The plants have been included in *Tripogandra glandulosa* because the morphological similarities are greater than with any other species. This decision is made reluctantly because it violates the morphological and geographic unity of the main body of collections. These plants seem to represent disjunct outliers of the main group of populations of *T. glandulosa* and with the apparent sterility, warrant further collection and study.

9. **Tripogandra grandiflora** (Donnell-Smith) Woodson, Ann. Missouri Bot. Gard. 29:153. 1942.

*Callisia grandiflora* Donnell-Smith, Bot. Gaz. 31:125. 1901. TYPE: **Guatemala.** ALTA VERAPAZ: Cubilguitz, 350 m., Apr. 1901, *von Tuerckheim* 7684 (Lectotype, US!; isolectotypes, GH!, MO!, US!).

*Donnellia grandiflora* (Donnell-Smith) Clarke in Donnell-Smith, Bot. Gaz. 33:261. 1902.

*Neodonnellia grandiflora* (Donnell-Smith) Rose, Proc. Biol. Soc. Wash. 19:96. 1906.

Illustrations: Donnell-Smith, Bot. Gaz. 33: Pl. XI. 1902; Moore, Jr., Baileya 8:78-80, Figs. 24, 26. 1960.

Plant perennial; stem first erect and later trailing over shrubs, to 3 m tall, to 1.0 cm in diam., unbranched or branched; internodes to 17 cm long, green, glabrous or with a complete or partial line of uniseriate hairs extending down the internode from the sheath above. Leaves two-ranked, narrowly ovate or elliptic, smaller apically and reduced to sheaths in the inflorescence; blades to 15.2 cm long, 4.4 cm wide, oblique at the base, cuneate on one side and rounded on the other, glabrous dorsally, ventral surface glabrous except for the midrib which is wholly or partially covered with uniseriate hairs, margin ciliate or entire with a few hairs near the sheath, apex acute; sheaths

of vegetative leaves to 16 mm long, 8.0 mm in diam. when dry, villous at the orifice, otherwise glabrous except for a complete or partial line of uniserate hairs extending down the side opposite the blade, sheaths of the cataphylls to 28 mm long, to 13 mm in diam., margin entire or ciliate. Inflorescences of a single terminal double cincinnus or paniculate, sometimes flexuous, composed of as many as 9 terminal and axillary double cincinni; peduncles to 4.0 cm long, or so reduced that cincinni appear sessile, green or dark green with lighter green flecks, glabrous or with 1 or 2 lines of uniseriate hairs; double cincinni with up to 13 buds, flowers and/or fruits; pedicels to 14 mm long at anthesis, to 1.3 mm in diam., green or green with a reddish tinge, glabrous, erect in fruit; bracts at the base of each pedicel entire, glabrous or with a few marginal uniseriate hairs. Flowers white; sepals narrowly ovate or elliptic, to 8.5 mm long, to 4.0 mm wide at anthesis, green or green with a pinkish base, glabrous, margin entire and hyaline, apex acute or obtuse; petals ovate, elliptic, or obovate, to 10.5 mm long, to 8.1 mm wide, cuneate at the base, apex obtuse; stamens 3, opposite the sepals, filaments 1.0-2.5 mm long, white, glabrous (Fig. 9), anthers 0.9-1.3 mm long, 0.8-1.2 mm wide, whitish, dorsifixed, versatile, open anther sacs white with a purple line around the edge (Fig. 8), pollen white; staminodes 3, opposite the petals, slightly epipetalous, filaments to 8.0 mm long, white, with two patches of uniseriate hairs in the upper half, the higher patch on the ventral side, the lower patch on the dorsal side with a few scattered hairs below the patch, filament bent in an open S-shape (Fig. 28), anthers dorsifixed, not versatile, connective orange or yellow, C-shaped with the anther sacs divergent, or connective elongate with anther sacs parallel, pollen yellow, sterile; ovary 0.7-1.6 mm long, 0.8-1.3 mm in diam., white or with a line of pink between the carpels, glabrous, style to 1.1 mm long, stigma simple or capitate and 3-lobed. Capsule elliptic, green or brown, glabrous, to 6.5 mm long; seeds gray or white and roughened, 1 or 2 per locule, elliptic (Fig. 77)

or triangular (Fig. 76), when elliptic with two sides upturned above the protuberant embryotega, to 5.0 mm long, when triangular with two sides and one end upturned forming an angular C-shaped ridge around the embryotega, to 3.0 mm long, hilum linear (Fig. 78).

Chromosome number: $n=8$, 16.

Vernacular name: hoja de fluxion, Standley and Steyermark, Guatemala, Fieldiana: Bot. 24(3):38. 1952.

Distribution and habitat: the Yucatán peninsula, southern México, Guatemala and British Honduras; at low elevations to 800-1500 m (7000-8800 ft, *Nelson* 3236c).

Flowering: Flowering occurs in August and September in the area surrounding Tuxtla Gutierrez in México and coincides with the rainy season in this location. In the area of Yucatán flowering occurs later, January to March and April. The fragrant flowers open sometime before sunrise and remain open until noon.

REPRESENTATIVE SPECIMENS

**México.** CHIAPAS: km. 1026 of Hwy. 190, 24 km. west of Ocozocuautla, 620 m., 13 Aug. 1967, *Handlos* 342 (BH). CAMPECHE: Monterrey, 22 Jan. 1932, *Lundell* 1225 (DS, F, MICH, US). **British Honduras.** EL CAYO: Augustine, Mountain Pine Ridge, 1450 ft., 18 Mar. 1960, *Hunt* 399 (BM, MICH, MO, US). **Guatemala.** PETEN: Santa Cruz, 27-28 Mar. 1931, *Bartlett* 12390 (F, MICH, US). ALTA VERAPAZ: between Cobán and Finca Chimoté, near Rubeltein, 800-1500 (300-500) m., 25 Feb. 1942, *Steyermark* 44203 (F, MO). IZABAL: Río Chacón, 300 ft., 10 Feb. 1921, *Johnson* 1266 (US).

Two different morphological forms can be distinguished within *Tripogandra grandiflora*. One form, representing the typical element, is more wide-spread and is characterized by leaves with a ciliate margin, a paniculate inflorescence, often with a flexuous axis and bearing 3-9 double cincinni, staminodes with a C-shaped connective and divergent anther sacs and commonly one seed per locule. Based on information on specimen labels the flowers are very fragrant. This form is found in the eastern portions of Guatemala, British Honduras, and southeastern México, the Yucatán peninsula and Chiapas.

The other form has leaves which lack the ciliate margin, there being only a few hairs at the base of the blade near the sheath. The inflorescence is composed of one to three double cincinni, the staminodes have an elongate, straight connective and the anther sacs are parallel. There are one or two seeds per locule. The flowers have a weaker fragrance if *Handlos* 342 is typical. While the evidence is limited there may also be a difference in a staminodial connective color, this form being yellow while the former is yellow or orange. The sterile pollen is more elongate in the typical element and more similar to the fertile pollen in *Handlos* 342. The second form is found in a restricted area in Chiapas, México, centering around Tuxtla Gutierrez (Ocozocuautla to San Cristóbal de las Casas).

At the present time the two forms seem to be undergoing independent evolution. There may be significant interactions and relationships between the pollinators and such floral characters as form and color of staminodes, and fragrance. If the two forms evolve in such a fashion that two distinct sets of pollinators are involved in pollination these two entities could retain their identity in the future if the populations become sympatric. Geographical isolation with some slight morphological and ecological differentiation now seems to exist. With further increase in differences these forms could be recognized as species but at this point in time it seems premature to give any nomenclatural recognition to these forms.

The United States National Herbarium is the location of two specimens which are held as the type material. According to the International Code of Botanical Nomenclature, Article 7, Note 3, only one specimen can serve as the holotype of the species. I designate the sheet (US 936917) which was annotated by C. V. Morton in August, 1940, as *Neodonnellia grandiflora*, as the lectotype with the other sheet (US 936916) to serve as an isolectotype. I have chosen this particular sheet because it holds both flowering and fruiting branches.

This species is distinguished by the revolute seed margin, the farinose seed surface, the two patches of hairs on the inner filaments, the elongate shape of the cells of the staminodial hairs and the sweetly scented flowers.

Reproduction in *Tripogandra grandiflora* is probably of two sorts, sexually by seeds and vegetatively from sections of fallen stem. Old stems fracture easily and in México I have found young plants attached to pieces of stems lying on the ground; the axillary bud at the base of the internode apparently began to grow when conditions became favorable, i.e., when sufficient moisture was available. Dispersal may be aided by the fact that the plants grow on hillsides and pieces of old stem could roll very easily to a new location. In areas with abundant tropical showers, pieces of stem could be carried and spread to new locations by water rushing down ravines and gullies.

10. **Tripogandra guerrerensis** Matuda, Anales Inst. Biol. Nac. México 36:113. 1966 ('1965'). TYPE: **México.** Guerrero: Rincón de la Via, 775 m., 24 Sept. 1961, *Kruse* 461 (Holotype, MEXU; isotype, MEXU!).

Illustration: Matuda, Anales Inst. Biol. Nac. México 36:113. 1966 ('1965').

Plants annual; stems erect, to 74 cm tall, 2-4 mm in diam. when dry, unbranched or with 1-2 branches basally; internodes 1.8-9.7 cm long, green, glabrous except for a line of uniseriate hairs continuing down the internode from the sheath on the side opposite the blade. Leaves narrowly ovate; blades 2.9-10.7 cm long, 0.3-1.1 cm wide, narrowed toward the base, smaller distally and leaves reduced to sheathing bracts in the inflorescence, glabrous ventrally, pilose dorsally, margin ciliate, apex acute; sheaths 2.0-12 mm long, villous at the orifice, otherwise glabrous except for a line of uniseriate hairs which continues down the side of the sheath opposite the blade. Inflorescences paniculate, much-branched, terminal and in the axils of the upper leaves, composed of 7-30 double cin-

cinni, peduncles 7-23 mm long, 0.4-0.6 mm in diam.; green, glabrous; bracts within the inflorescence with short lamina or reduced to a sheath near the apex; buds, flowers and/or fruits 1-5 per double cincinnus; pedicels 1.4-3.5 mm long, 0.3-0.4 mm in diam., green, glabrous or with a few scattered uniseriate or capitate hairs, erect in fruit; bracts subtending the pedicels glabrous, margin entire. Flowers white; sepals ovate-cymbiform, 2.3-3.2 mm long, 1.5-2.1 mm wide, green with purple tips, glabrous or with a few scattered capitate hairs, margin entire, apex acute or obtuse; petals ovate-elliptic, 3.5-5.0 mm long, 2.3-3.5 mm wide, tapering at the base, apex obtuse; stamens 3, opposite the sepals, filaments 1.0-1.1 mm long, white, glabrous basally but bearded dorsally in the middle with a few uniseriate, colorless hairs (Fig. 11), anthers 0.6-0.7 mm long, 0.4-0.5 mm wide, white, basifixed, versatile with anther sacs parallel, longer than the gibbous connective, pollen white; staminodes 3, opposite the petals, filaments slightly epipetalous, 3.5-4.5 mm long, white, glabrous, bent in an S-shape in the upper half, expanded in the bent portion (Figs. 15, 17), anthers dorsifixed, versatile, filaments attached near one side of the yellow, discoid connective and anther sacs borne on the side opposite the filament, connective 0.6-0.8 mm long, 0.5-0.7 mm wide, pollen yellow, sterile; ovary 0.6-0.8 mm long, 0.6-0.8 mm in diam., light green, glabrous, style 0.2-0.3 mm long, stigma simple, papillate. Capsule obovoid, glabrous, light brown, 2.9-3.6 mm long, 2.2-2.5 mm in diam.; seeds 2 per locule (Fig. 49), the upper in each locule longer (Figs. 70, 71), 1.6-1.9 mm, the lower shorter, 1.1-1.4 mm (Figs. 68, 69), triangular to elliptical, dark brown to black, testa areolate with ribs radiating from the embryotega, hilum linear-elliptical (Figs. 69, 71).

Chromosome number: $n=8$.

Distribution and habitat: México in the states of Jalisco and Guerrero; in rocky areas at low elevations. This species is known from two locations which are about 455 km apart. The intervening area is not easily accessible but it seems highly probable that there are other suitable habitats be-

tween the two known locations, and as the area is explored new collections will almost certainly be made.

Flowering: Flowering occurs in September and October in the two locations where this species has been collected. Flowers in México and in the greenhouse at Ithaca, N.Y., open about 11:00 AM and close about 2:30 PM.

SPECIMENS EXAMINED

**México.** JALISCO: just before km. 148 on Hwy. 110 to Colima, 5.6 km. south of bridge over Río San Pedro, ca. 1050 m., 2 Oct. 1967, *Handlos* 438 (BH); km. 147-148 on road between Colima and Mazamitla, 1040 m., 10 Sept. 1961, *Moore, Jr. & Bunting* 8746 (BH, UC).

*Tripogandra guerrerensis* is unique among the species I have seen in México because the petals are not symmetrically disposed at anthesis; rather, two petals bend upward so that an angle of approximately 90° is formed between the middle upright petal and the two lateral ones, whereas in all the other species the angle between petals is about 120°.

The androecium bears a constant relationship to the petals. In typical *Tripogandra*-fashion, the filaments of two of the staminodes bend around two staminal filaments and the three staminodes are then positioned in front of the middle upright petal. The stamens surround the ovary but because of the position of the petals and staminodes the anthers can not be approached by a pollinator alighting on the petals. From observations made of a natural population in Jalisco, México, on October 2 and 3, 1967, the disposition of the petals seems significant because bees are restricted in their movements and are able to gather pollen only by clinging to the staminodes. If the pollinator collects sterile pollen, it hangs from the filaments of the sterile stamens, with its abdomen pointed toward the center of the flower. While gathering sterile pollen, the abdomen is placed on the fertile anthers so that pollen is deposited on the pollinator's abdomen. This seems to be a device for insuring pollination. Insects are also able to collect fertile pollen by clinging upside down to the

staminodes with the head near the anthers. Further critical studies are needed to determine how much cross-pollination and how much self-pollination is effected. In the greenhouse, abundant viable seed was set after insects ceased entering from outdoors, so the plants are not self-sterile.

11. **Tripogandra kruseana** Matuda, Anales Inst. Biol. Nac. México 37:77, 78. 1967 ('1966'). HOLOTYPE: **México.** GUERRERO: Rincón de la Via, 735 m., 16 Oct. 1965, *Kruse* 903 (MEXU!).

Illustration: E. Matuda, Anales Inst. Biol. Nac. México 37:77. 1967 ('1966').

Plants perennial?, rooting at the nodes; flowering stems erect, to 61 cm tall, branched at the base; internodes to 9.5 cm long, with a partial line of uniseriate hairs extending down the side from the sheath above, otherwise glabrous in the lower portion of the plant. Leaves narrowly ovate; blades to 10.1 cm long, to 1.2 cm wide, glabrous, margin ciliate, apex long acuminate; sheaths to 12 mm long, to 1.0 cm in diam., a few long hairs at the orifice, with a line of uniseriate hairs on the side opposite the blade, otherwise glabrous. Inflorescences borne terminally and in the upper 3 leaf axils, composed of up to 9 double cincinni; peduncles to 1.3 cm long, pilose with capitate hairs; buds, flower and/or fruits 2-3 per double cincinnus; pedicels 8-12 mm long, green, erect in fruit, pilose with capitate hairs; bracts at the base of each pedicel with margin entire or denticulate. Flowers pink (white fide label); sepals ovate, 3.1 mm long, 1.6 mm wide in flowers available (2 mm long, 1.2 mm wide fide desc.), pilose with capitate hairs, margin red; petals not available; stamens 6, in two whorls, 3 shorter, 0.7 mm long, bearded with white moniliform hairs; 3 larger, 2 mm long, bearded with white moniliform hairs; ovary green, glabrous, style short, stigma capitellate. Capsule globose, 2.5 mm long, 2.5 mm in diam. (immature).

Distribution and habitat: This species is known only from the type collection at Rincón de la Via, Guerrero, México, in a rocky area at 735 m. altitude.

Flowering: The type specimen was in flower in mid-October.

Matuda's original description of *T. kruseana* describes the base of the leaf as amplexicaul but this is not readily discernible in the holotype. If the plant has amplexicaul leaves and is a perennial, it will key out to *T. encolea*. If the plant lacks amplexicaul leaves, as the photograph of the holotype seems to indicate, it will key near *T. saxicola* from which it may be distinguished by erect pedicels and pilose peduncles.

12. **Tripogandra montana** Handlos, *sp. nov.* HOLOTYPE: **México.** CHIAPAS: 3.2 miles N of junction of Hwy. 195 with road to El Bosque and Simojovel, 1770 (1690) m., 15 Aug. 1967, *Handlos* 355 (US!).

*Herba* perennis; *caulis* decumbens, usque ad 2.6 m longus, internodiis usque ad 12.8 cm longis, glabris vel raro distaliter pilosis, linea unica pilorum instructis. *Folia* angusto-ovata, laminis usque ad 14.5 cm longis, usque ad 3.5 cm latis, apice acutis, basi obliquis, glabris vel pilis paucis dispersis instructis vel pilosis, margine ciliatis vel medio nonnunquam eciliatis, vaginis usque ad 18.0 mm longis, usque ad 12.5 mm diam., linea unica pilorum instructis, aliter glabris vel pilis dispersis instructis vel pilosis, orificio villosis vel pilis dispersis praeditis. *Inflorescentiae* terminales et in 1-4 axillis foliorum summorum, ex 1-17 cincinnis duplicibus constantes; *pedunculi* 0.7-12.7 cm longi, glabri, pilosi vel 1-2 lineis pilorum instructi; *cincinni* duplices omnes alabastra, flores, vel fructus usque ad 17 gerentes; *pedicelli* usque ad 2.5-6.0 mm longi, 0.6-0.8 mm diam., maturitate reflexi, pilis capitatis paucis instructi vel pilosi, bracteis basi pedicellorum glabris vel pilis capitatis vel uniseriatis dispersis pubescentibus, margine ciliatis vel eciliatis. *Flores* rosei; *sepala*

anguste ovata, elliptica, vel obovata, cymbiformia, 4.0-6.0 mm longa, 1.6-2.8 mm lata, pilosa vel pilis paucis, dispersis, capitatis instructa, margine integra et hyalina, apice obtusa; *petala* ovata, 5.5-11.0 mm longa, 3.5-6.8 mm lata, basi cuneata, apice rotundata; *stamina* 6 in verticillis duobus, 3 sepalis opposita filamentibus brevibus, 1.0-2.5 mm longis, subroseis, glabris vel raro pilis paucis praeditis (Fig. 10), antheris 0.8-1.8 mm longis, 0.6-1.2 mm latis, polline albido, 3 petalis opposita filamentibus epipetalis, sigmoideis, 4.5-7.5 mm longis, medio pilis roseis moniliformibus pubescentibus (Fig. 31), antheris 0.5-0.9 mm longis, 0.5-1.1 mm latis, polline luteo; ovarium 1.2-1.7 mm longum, 0.8-1.2 mm diam., glabrum, stylo 0.2-0.6 mm longo, stigmate capitellato vel capitato. *Capsula* elliptica, 2.0-3.7 mm longa, 1.6-2.6 mm diam., glabra, seminibus triangularibus, 1.1-1.7 mm longis, reticulatis (Figs. 44-46), hilo punctiformi (Fig. 45).

Chromosome number: $n=21$.

Vernacular name: tzima fide Standley, Guatemala.

Distribution and habitat: southern México, Guatemala, Honduras, and El Salvador; in pine-oak forest areas at higher elevations, ca. 1100-2500 m. The one undisturbed location in which I found this species was in a black loam soil in a pine woods with a scattering of oaks, *Liquidambar* and tree ferns. The plants grew on a moist, east-facing slope. An adjacent, drier, sunnier and steeper west-facing slope had no plants of this species.

Flowering: In México flowering occurs between March and November; in Guatemala between November and June; in Honduras in February, March, April, July and November. The flowers open about 8:00 AM in their natural habitat and close about 2:00 PM. The plants I found had odorless flowers. Flowering seems to extend over a long period of time because both young inflorescences and mature seed were found in the location where *Handlos* 355 was collected.

REPRESENTATIVE SPECIMENS

**México.** CHIAPAS: in the paraje of Kulak'tik, Municipio of Tenejapa, 5500 ft., 25 Nov. 1965, *Breedlove* 14205 (DS, F, MICH). **Guatemala.** HUEHUETENANGO: Canyon of Río Chixoy near Malacatancito about 20 km. southwest of Huehuetenango, 1600 m., 1 Dec. 1962, *Williams, Molina R. & Williams* 22149 (F, NY). QUICHE: Cunen, 6000 ft., Apr. 1892, *Heyde & Lux* 3521 (GH, M, NY, US). ALTA VERAPAZ: Chicoyonito, 4300 ft., Apr. 1889, *Donnell-Smith* 1643 (GH, NY, PH, US). SAN MARCOS: slopes bordering Río Malacáte, barrancos 6 miles south and west of town of Tajumulco, northwestern slopes of Volcán Tajumulco, 2300-2800 m., 26 Feb. 1940, *Steyermark* 36679 (F). QUEZALTENANGO: mountains above Río Samalá, Sierra Madre Mountains, 2 km. west of Zunil, 2300 m., 14 Dec. 1962, *Williams, Molina R. & Williams* 23023 (F, NY). SOLOLA: steep slopes of Panajachel water falls, road to Solalá, 2200 m., 12-23 Jan. 1966, *Molina R.*, *Burger & Wallenta* 16233 (F, NY). CHIMALTENANGO: near Río Pixcayó, between Chimaltenango and San Martín Jilotepeque, 1650-1800 m., 3 Feb. 1939, *Standley* 64362 (F). SACATEPÉQUEZ: slopes of Volcán de Agua, south of Santa María de Jesús, 1800-2100 m., 10 Dec. 1938, *Standley* 59449 (F). GUATEMALA: damp wooded barranca 10 km. south of San Raimundo, about 1800 m., 18 Jan. 1939, *Standley* 62882 (F). EL PROGRESO: Montaña Canahui, between Finca San Miguel and summit of mountain, near upper limits of Finca Caieta, 1600-2300 m., 10 Feb. 1942, *Steyermark* 43764 (F). ZACAPA: along Rillito del Volcán de Monos, Volcán de Monos, 1150-2100 m., 10 Jan. 1942, *Steyermark* 42336 (F, MO). CHIQUIMULA: Montaña Nonojá, 3-5 miles east of Camotán, 600-1800 m., 11 Nov. 1939, *Steyermark* 31687 (F). SUCHITEPÉQUEZ: southwestern lower slopes of Volcán Zunil, in vicinity of Finca Montecristo, southeast of Santa Mariá de Jesús, 1200-1300 m., 31 Jan. 1940, *Steyermark* 35221 (F). **Honduras.** COPAN: 5 km. al S.O. de Santa Rosa de Copán, 1200 m., 29 Mar. 1963, *Molina R.* 11675 (F). COMAYAGUA: vicinity of Siguatepeque, 1080-1400 m., 14-27 Feb. 1928, *Standley* 56198 (F, US). INTIBUCA: Baños de Esperanza, 1800 m., 27 Nov. 1958, *Hawkes, Hjerting & Lester* 2103 (C, F). **El Salvador.** Santo Tomás, 1922, *Calderón* 1294 (NY, US).

The collections which I have included in *Tripogandra montana* have usually been identified as *T. elongata* in the past. On the basis of a distinct seed reticulation, a capitate stigma, a short style, a different leaf texture, adaptation to a relatively moist montane habitat, and a different and distinct geographic range, I must recognize *T. montana* as different from *T. elongata*. *Tripogandra elongata* is

discussed further under *T. serrulata*. The long peduncles and bright pink flowers of *T. elongata* may indicate some affinity with *T. montana* but this is only speculation.

Variation in leaf vesture does occur within this taxon but that seems to be a common occurrence within this genus. The significance, function, and mode of inheritance of this character should be investigated further.

13. **Tripogandra multiflora** (Swartz) Rafinesque, Flora Telluriana 2:16. 1837 ('1836').

*Tradescantia multiflora* Swartz, Nova genera & species plantarum seu prodromus . . . Indiam occidentalum 57. 1788; Flora Indiae occidentalis 1:599. 1797; 3:1972. 1806; Jacquin, Collectanea ad botanicam . . . 3:226, 227. 1791. TYPE: **Jamaica.** *Swartz* (Holotype, (B)?; isotype, M!).

*Tradescantia parviflora* Ruiz & Pavon, Florae Peruvianae et Chilensis prodromus, . . . 3:43. 1794. TYPE: **Perú.** HUANUCO: Pozuzo, 1778-1788, *Ruiz & Pavon.* (Holotype, MA; photograph, MA!; isotype, F!).

*Tradescantia procumbens* Willdenow, Species Plantarum 2:19 1799. HOLOTYPE: *Jacquin* (B); photograph, B!.

*Commelina floribunda* HBK., Nova genera et species plantarum 1:260. 1816. HOLOTYPE: Cumana, Bordones & Quetepe, *Humboldt & Bonpland* (B); photograph, B!.

*Heminema multiflora* (Swartz) Rafinesque, Flora Telluriana 2:17. 1837 ('1836').

*Aneilema floribunda* (HBK) Hooker & Arnott, The Botany of Captain Beechey's Voyage 311. 1840.

*Tradescantia cumanensis* Kunth, Enumeratio Plantarum 4:96. 1843, based on *Commelina floribunda* HBK non *Tradescantia floribunda* M. & G. (1842) nec *T. floribunda* Kunth (1843).

*Tradescantia multiflora* γ *linnaei* Clarke in DC., Monographiae Phanerogamarum 3:306. 1881. TYPE:

**Colombia.** in montibus juxta Bogotam, 6 Nov. 1852, *Holton* 127 (Holotype, K!; isotype, NY!).

*Tradescantia multiflora* β *parviflora* (Ruiz & Pavon) Clarke in DC., Monographiae Phanerogamarum 3:306. 1881.

*Descantaria procumbens* Schlechtendal fide Hasskarl ex Clarke in DC., Monographiae Phanerogamarum 3:305. 1881, *nom. nud. pro syn.*

*Leptorhoeo floribunda* (HBK) Baillon, Histoire des Plantes 13:218. 1894 ('1895').

*Tradescantia ionantha* Diels in Urban, Bot. Jahrb. Syst. 37:382. 1906. TYPE: **Perú.** PUNO: Sandia, 2100 m., 24 Mar. 1902, *Weberbauer* 588 (Holotype, B!; isotype, G!).

*Tradescantia multiflora* var. *tobagensis* Urban, Symbolae Antillanae 7:174. 1912. HOLOTYPE: **Tobago.** juxta flumen "Bacolet" ad "Calder Hall", 31 Oct. 1889, *Eggers* 5693 (B!).

*Descantaria multiflora* (Swartz) Brückner, Notizbl. Bot. Gart. Berlin-Dahlem 10:56. 1927.

*Descantaria cumanensis* (Kunth) Schlechtendal ex Brückner, Notizbl. Bot. Gart. Berlin-Dahlem 10:56. 1927.

*Descantaria ionantha* (Diels) Brückner, Notizbl. Bot. Gart. Berlin-Dahlem 10:56. 1927.

*Tripogandra floribunda* (HBK) Woodson, Ann. Missouri Bot. Gard. 29:152. 1942.

*Tripogandra cumanensis* (Kunth) Woodson, Ann. Missouri Bot. Gard. 29:152. 1942.

*Tripogandra ionantha* (Diels) Macbride, Revista Univ. (Cuzco) 33(87):142. 1945.

*Tripogandra parviflora* (Ruiz & Pavon) Steyermark, Phytologia 9:339. 1963 ('1964').

*Tripogandra multiflora* (Swartz) Woodson [fide Bacigalupo] forma *parviflora* (Ruiz & Pavon) Bacigalupo, Darwiniana 14:398. 1967.

Illustrations: Jacquin, Icones Plantarum rariorum 2: 355. 1790 ('1781-1795'); Moore, Jr., Baileya 8:81, Fig. 27. 1960; Bacigalupo, Darwiniana 14:399, Fig. 1, 1967.

Plants perennial, trailing and rooting at the nodes or caespitose; floriferous stems upright, to 83 cm tall, unbranched or branched; internodes to 13.5 cm long, the uppermost 1-4 pilose (rarely glabrous), the lower glabrous or glabrous proximally and pilose distally, in all specimens with a line of uniseriate hairs extending down the stem from the sheath above. Leaves narrowly ovate, ovate or broadly ovate; blades to 8.8 cm long, to 2.8 cm wide, glabrous or pilose dorsally, the ventral surface variously glabrous, pilose and/or with a line or band of uniseriate hairs near the margin, occasionally the base of the midvein with a line of uniseriate hairs, base oblique, cuneate, or rounded, margin ciliate, apex acute; sheaths to 14.2 mm long, to 9.2 mm in diam., villous at the orifice, the uppermost 1-7 pilose (rarely glabrous), the lower ones glabrous or pilose, in all specimens with a line of uniseriate hairs extending down the side opposite the blade. Inflorescences of 1-26 double cincinni borne terminally and in the axils of the upper 1-8 leaves; peduncles to 3.5 (-5.4) cm long, densely pilose or rarely pilose distally and glabrous proximally; double cincinni with up to 16 buds, flowers and/or fruits; pedicels 1.4-4.0 mm long, reflexed in fruit, glabrous, with scattered uniseriate hairs or pilose; bracts at the base of each pedicel glabrous, with scattered uniseriate hairs, or pilose, margin entire or long-ciliate. Flowers white or pink; sepals ovate-cymbiform, 1.8-4.0 mm long, 1.0-1.8 mm wide, green, red, or green with a red tip and/or base, glabrous, with scattered capitate hairs, or pilose, margin hyaline, apex more or less acute; petals broadly ovate(?), 1.6-4.0 mm long, 1.0-ca. 2.2 mm wide; stamens 6, in two whorls, the outer shorter, filaments 0.5-1.3 mm long, glabrous, anthers 0.3-0.6 mm long, 0.3-0.6 mm wide, pink, basifixed, anther sacs parallel; stamens of the inner whorl longer, 1.4-3.2 mm long, S-shaped, bearded with a ventral

tuft of moniliform hairs below the expanded distal end, anthers 0.3-0.5 mm long, 0.2-0.8 mm wide, dorsifixed, connective I- or C-shaped, yellow, anther sacs divergent or parallel through bending of the connective; ovary 0.5-1.0 mm long, 0.4-0.8 mm in diam., glabrous, style 0.15-0.3 mm long, stigma capitellate or capitate. Capsules 1.4-2.5 mm long, 1.5-2.5 mm in diam., green or light brown, glabrous; seeds 1-2 per locule, rounded-triangular, 0.7-1.0 (-1.4) mm long, light or dark gray or brown, testa reticulate-foveate (Figs. 32, 34), hilum punctiform (Figs. 33, 35).

Chromosome number: $2n=64$ (A. Sparrow, pers. comm.)

Distribution and habitat: Jamaica, Trinidad, Tobago, Costa Rica, Venezuela, Colombia, Perú, Bolivia, and Argentina; on shaded or open rocky banks or slopes from sea level to 2900 m.

Flowering: In Jamaica flowering occurs from June to February; in Trinidad and Tobago in July and October; in Costa Rica in November; in Venezuela from August to January and in May and June; in Colombia from May to February; in Perú in March, July, November, and December; in Bolivia from December to May.

REPRESENTATIVE SPECIMENS

**Jamaica.** Troy, 2000 ft., 16 Oct. 1917, *Harris* 12573 (F, NY, US). MANCHESTER: vicinity of Mandeville, 15-26 Feb. 1910, *Brown* 84 (NY, PH). ST. ANDREW: off road from Kingston to Newscastle, 1250 ft., 17 June 1963, *Crosby, Hespenheide & Anderson* 178 (F, MICH, MSC, UC). **Tobago.** Roxborough, 20 July 1914, *Broadway* 4906 (US); Mason Hall, 19 Oct. 1937, *Sandwith* 1865 (NY). **Trinidad.** Point opposite Melville Island, 25 Oct. 1925, *F[reeman] & W[illiams]* 11408 (NY). **Costa Rica.** SAN JOSE: vicinity of El General, 1160 m., Nov. 1936, *Skutch* 2935 (GH, K, MO, NY, US). **Venezuela.** FALCON: Meachiche, 18 Jan. 1942, *Lasser* 178 (US, VEN). LARA: Loma de León Dto. Yribarren, 16 Sept. 1950, *Tamayo* 3726 (VEN). DISTRITO FEDERAL: La Quesera, Upper Cotiza, near Caracas, above 1400 m., 18 Sept. 1921, *Pittier* 9821 (US, VEN). MIRANDA: Los Mariches, on new road to Sta. Lucia, 14 Dec. 1924, *Pittier* 11636 (US, VEN). MERIDA: 3 miles west; 2 miles south of Mérida Valley, 4500 ft., 26 Jan. 1931, *Reed* 335 (US). **Colombia.** MAGDALENA: Sierra Nevada de Santa Marta, southeastern slopes; Hoya del Río Donachuí; below the vil-

lage Donachuí near the river, 1350-1230 m., 24 Sept. 1959, *Cuatrecasas & Castaneda* 24406 (US). NORTE DE SANTANDER: vicinity of Mutiscua, 2900 m., 20-22 Feb. 1927, *Killip & Smith* 19669 (US). SANTANDER: vicinity of Charta, 2000-2600 m., 1-11 Feb. 1927, *Killip & Smith* 17446 (GH, NY, US). BOYACA: Valle de la Uvita, Cordillera Oriental, 2490-2560 m., 16 Sept. 1938, *Cuatrecasas* 1857 (US). CUNDINAMARCA: Macizo de Bogotá, Quebrada de Chicó, 2650-2750 m., 1 June 1939, *Cuatrecasas* 5224 (US). HUILA: Cordillera Oriental, east of Neiva, 800-1000 m., 31 July 1917, *Rusby & Pennell* 424 (NY). **Perú.** SAN MARTIN: prope Tarapoto, 1855-6, *Spruce* 4198 (BM, BR, E, NY). HUANUCO: west and above Puente Durand, north of Huanuco, 1900 m., 4 Nov. 1938, *Stork & Horton* 9589 (G, GH, K). LIMA: Lima, 1 July 1914, *Rose & Rose* 18551 (US). CUSCO: Potrero, Convención, 1300 m., 2 Mar. 1940, *Vargas C.* 1832 (GH). PUNO: Sandia, 2100 m., 24 Mar. 1902, *Weberbauer* 588 (B, G). **Bolivia.** LA PAZ: Apolo, 4800 ft., 10 Mar. 1902, *Williams* 55 (BM, US).

*Tripogandra multiflora* is a widespread species in South America and a complex pattern of variation seems to exist within the species as I conceive it. Collections below about 2,000 meters from Colombia, Venezuela and the Caribbean islands form a fairly uniform group characterized by a trailing habit, glabrous leaves with an oblique base, white flowers and pilose sepals.

Collections from Bolivia in contrast are quite variable. The leaf base is usually oblique and the base of the plant seems to be decumbent. The flower color may be either white or pink, sometimes even in the same collections, e.g., *Buchtien* 399. The leaf indument is variable — the leaves may be (1) glabrous dorsally with a band of hairs near the margin ventrally as in *Williams* 55; or (2) pilose on both sides as in *Rusby* 1369, *Buchtien* 2457, 4183 (F, GH), 7190 (GH), *Bang* 603 (F, M, MICH); or (3) pilose dorsally with a ventral marginal band of hairs as in *Buchtien* s.n., 399 (US), 4183 (F), 7190 (NY), *Bang* 603 (E, F, GH, MO, PH, US). The sepals may be glabrous as in *Williams* 55, *Buchtien* s.n., 399 (US), 4183 (F), 5350, 7190 (NY), *Bang* 603 (E, F, GH, MO, NY, PH, US), or have scattered capitate hairs as in *Rusby* 1369, *Buchtien* 399 (US), 2457 (NY), 4183 (GH), 7190 (GH), *Bang* 603 (M, MICH); or be pilose as *Buchtien* 4183 (F, G). These plants must be studied in

the field for a better understanding of the problems. I do not know whether hybridization is occurring. It is possible that collections have become mixed before being glued to herbarium sheets; most collections were made by Buchtien and Bang. It is possible, however, that the species in Bolivia is very polymorphic with some obvious traits segregating within the populations.

Plants which grow in the highlands of Colombia, Perú and Bolivia, above 2,000 meters elevation, tend to be caespitose and the leaves are generally broadly ovate with a cuneate to nearly amplexicaul base. Compared to lowland plants of *T. multiflora* there are few inflorescences and these are partially covered by the upper one to five leaves; the sepals, petals and pistil tend to be longer and the stigma is broader, more nearly capitate than capitellate. The flowers are always bright pink or magenta. I can find no qualitative characters (aside, perhaps, from flower color) which will allow one to separate the plants of this group from the bulk of *T. multiflora*. The presence of plants which appear intermediate between the highland and lowland forms leads me to consider the highland plants as a mountain ecotype of *T. multiflora*. Intergradation as seen from herbarium specimens may be more apparent than real. It is possible that these forms are ecologically separated and generally do not intergrade but are very similar species. If one considers evolution to be a continuous and gradual process and not saltational, then it is possible that the situation just described represents a slight ecological divergence with no overwhelming morphological differences, a case of sibling or micro-species. These essential questions can only be settled with further field work.

Because of the pattern of morphological variations occurring within *Tripogandra multiflora*, a number of names have been applied to this species. These names are considered in detail here.

Willdenow (1799) named *Tradescantia procumbens* from a collection with a procumbent stem from mainland South

America. This name seems unnecessary for there appear to be no other characters by which the island and the mainland populations differ. Observations of greenhouse grown plants and information on herbarium labels indicate that, in fact, the island plants also tend to trail over the ground.

Ruiz and Pavon's *Tradescantia parviflora* does not seem sufficiently distinct to be recognized as a species, the only distinguishing character being the presence of pilosity on the dorsal leaf surface. Clarke (1881) considered *T. parviflora* a variety ($\beta$) of *Tradescantia multiflora*. No other collections that I have seen duplicate the distribution of hairs found on the Ruiz and Pavon specimen. The other collections cited under variety *parviflora* by Clarke have additional hairs in a line near the margin on the ventral surface which are not found in the Ruiz and Pavon specimen. Bacigalupo (1967) considered *Tradescantia parviflora* a form of *Tripogandra multiflora*. The specimen which he cites from Argentina apparently has additional indument on the ventral leaf surface not found on the Ruiz and Pavon specimen. In terms of the distribution of hairs on the leaves, the Ruiz and Pavon specimen seems, therefore, to be an intermediate between the Bolivian, Argentinian and other Peruvian collections and the Colombian, Venezuelan and Jamaican glabrous-leaved plants. Steyermark (1963) cited specimens of *Tripogandra parviflora* from Ecuador but apparently these are referable to a species of *Gibasis*.

Urban's variety *tobagensis* of *Tradescantia multiflora* is represented by a very few collections. While the seeds he observed were 0.6-0.7 mm in diameter, I find that seeds from other collections on Trinidad and Tobago range from 0.7-1.0 mm in diameter. The plants do seem smaller but a formal Latin designation seems unnecessary. The small stature of the plants may represent only stunted growth and no real genetic difference.

The mountain ecotype described earlier was named *Tradescantia multiflora* variety $\gamma$ *linnaei* by Clarke (1881)

and *T. ionantha* by Diels (in Urban, 1906). Judging from herbarium specimens there seems to be no character except, perhaps, the bright magenta flower color by which these plants can be distinguished.

The names *Tradescantia cumanensis* and *Tripogandra cumanensis* have been applied to specimens of *Tripogandra serrulata*, but these usages seem to stem from an initial misidentification of specimens by Clarke. Kunth's original description of *Tradescantia cumanensis* (as *Commelina floribunda*) notes that the top of the stem and the peduncle are "hirto-pilosis" while the sepals are "glanduloso-pilosis." These characters coincide with those found in *T. multiflora* which is common in Venezuela where the type of *T. cumanensis* was collected, but these characters are not found in *T. serrulata* which seems to be rare or at least not often collected in Venezuela.

Kunth's concept of similarities may be considered as a further line of evidence to demonstrate the identity of *T. multiflora* and *T. cumanensis*. Kunth (1843) grouped similar species in his treatment of the family and he noted the affinities he believed existed. It can be seen that *Tradescantia schlechtendalii* (a synonym for *Tripogandra serrulata*) is number 41 in Kunth's list while *T. procumbens*, *T. parviflora*, *T. multiflora*, and *T. cumanensis* are numbers 44, 45, 46, and 47, respectively. Using this evidence as a reflection of similarities, *T. cumanensis* stands apart from *T. schlechtendalii* (=*Tripogandra serrulata*) but close to *T. multiflora*. I have only seen a photograph of the holotype of *T. cumanensis* but an examination of seeds of this specimen would make a positive indentification possible.

By application of the Internal Code of Botanical Nomenclature, *Aneilema floribunda*, *Leptorhoeo floribunda* and *Tripogandra floribunda* based on *Commelina floribunda* HBK must be cited in synonymy under *Tripogandra multiflora* for reasons which follow.

Hooker and Arnott published the combination *Aneilema floribunda* based on *Commelina floribunda* HBK but the

specimen to which they applied this name was a species of *Leptorhoeo,* a genus in need of further study. Subsequent authors, Baillon (1894) and Woodson (1942), have credited Hooker and Arnott as authors of the specific epithet, *floribunda,* but Hooker and Arnott correctly credited HBK and did not, in fact, publish a new species description though they did apply the name incorrectly.

Rohweder (1956) published *Tripogandra ionantha* and Steyermark (1964) published *T. multiflora* as new combinations. Both of these names were validly published earlier so neither Rohweder nor Steyermark can be credited as the correct authors.

14. **Tripogandra neglecta** Handlos, *sp. nov.* HOLOTYPE: **Brazil.** MINAS GERAIS: ad Lagoa Sta., 27 Mar. 1864, *Warming* 1069/1(C!).

*Herba* annua(?); *caulis* erectus, usque ad 40 cm altus, internodiis usque ad 10.5 cm longis, linea unica pilorum instructis aliter glabris. *Folia* angusto-ovata, laminis usque ad 11.3 cm longis, usque ad 2.1 cm latis, apice acutis, basi cuneatis, glabris, margine ciliatis, vaginis usque ad 2.3 cm longis, usque ad 1.0 cm diam., linea unica pilorum instructis, aliter glabris, orificio parce villosis. *Inflorescentiae* terminales et in axillis foliorum summorum, ex 4-9 cincinnis duplicibus constantes; *pedunculi* usque ad 4.0 cm longi, 1-2 lineis pilorum instructi, cincinni duplices omnes alabastra, flores, vel fructus usque ad 12 gerentes; *pedicelli* usque ad 5.5 mm longi, glabri, maturitate reflexi, bracteis basi pedicellorum margine integris, glabris. *Flores* albi?; *sepala* ovata, cucullata, usque ad 4.0 mm longa, usque ad 2.3 mm lata, pilis paucis uniseriatis instructa, margine integra et hyalina, apice ± obtusa; *petala* ovata, apice obtusa; *stamina* 6 in verticillis duobus, 3 sepalis opposita filamentibus brevibus, usque ad 1.3 mm longis, glabris, antheris usque ad 1.1 mm longis, usque ad 1.2 mm latis, 3 petalis opposita filamentibus longioribus, usque ad 3.2 mm longis, sigmoideis, barbatis distaliter, antheris usque ad 0.8 mm longis, usque ad 1.2 mm latis, connectivo C-

formi; *ovarium* usque ad 1.0 mm longum, usque ad 0.8 mm diam., glabrum, stylo usque ad 0.6 mm longo, stigmate simplici. *Capsula* globosa, usque ad 3.0 mm longa, usque ad 3.1 mm diam., glabra, seminibus triangularibus, usque ad 1.6 mm longis, minute reticulatis, hilo punctiformi.

Distribution and habitat: Known only from one location in Brazil.

Flowering: The one specimen available was in flower and fruit in March.

SPECIMENS EXAMINED

**Brazil.** MINAS GERAIS: ad Lagoa Santa, 27 Mar. 1864, *Warming* 1069/2 (C); without precise location: *Warming* (C).

This rarely collected species is similar to *Tripogandra diuretica* from which it differs in the shape of the leaf base, the unique presence of a few uniseriate hairs at the junction between adjacent sepals, the flower color, the surface texture of the testa and duration (apparently).

15. **Tripogandra palmeri** (Rose) Woodson, Ann. Missouri Bot. Gard. 29:153. 1942.

*Tradescantia palmeri* Rose, Contr. U.S. Nat. Herb. 1:113. 1891. TYPE: **México.** SONORA: Alamos, 16-30 Sept. 1890, *Palmer* 737 (Holotype, US!; isotypes, GH!, NY!).

*Descantaria palmeri* (Rose) Brückner, Notizbl. Bot. Gart. Berlin-Dahlem 10:56. 1927.

Illustration: Matuda, Anales Inst. Biol. Nac. México 26:374. 1956 ('1955'). The magnification is given as ×½ but it is more nearly ×1.

Plants annual; stems erect, to 45 cm tall, to 4.0 mm in diam. when dry, unbranched to branched at every node (6 branches); internodes to 11.7 cm. long, green, glabrous to pilose. Leaves elliptic, narrowly ovate, or ovate; blades 0.7-9.5 cm long, 0.2-4.0 cm wide, cuneate, rounded or truncate at the base, dorsal surface glabrous or pilose, ventral surface variously glabrous, glabrous with a few uniseriate hairs along the base of the midvein, or pilose, margin

ciliate, apex acute; sheaths 1.0-9.5 mm long, 0.6-9.5 mm in diam. when dry, villous at the orifice, with a line of hairs extending down the side opposite the blade, otherwise glabrous or pilose. Inflorescences borne terminally and in the axils of the upper leaves; peduncles to 5.4 cm long, or so reduced that cincinni appear sessile, green, proximally glabrous or pilose, hairs uniseriate, distally variously glabrous, with a few scattered hairs, or pilose, hairs capitate; cincinni with 2-21 buds, flowers and/or fruits; pedicels 1.5-8.0 mm long at anthesis, 0.3-0.6 mm in diam., green, variously glabrous, with a few scattered capitate hairs, or pilose, erect at anthesis and in fruit; bracts at the base of the pedicels with an entire margin, glabrous or with a few scattered capitate hairs. Flowers white; sepals cymbiform, elliptic to ovate, 1.5-4.1 mm long, 1.0-2.3 mm wide, green with the tip darker, pilose or with a few scattered capitate hairs, margin entire and hyaline, apex acute or obtuse; petals elliptic, ovate, or obovate, 2.0-4.5 mm long, ca. 1.0-5.0 mm wide, cuneate at the base, apex obtuse or rounded; stamens 3, opposite the sepals, shorter than the staminodes, filaments 0.5-1.2 mm long, colorless with a few (1-6) uniseriate hairs on the upper half of the dorsal side (Fig. 13), anthers 0.3-1.0 mm long, 0.2-0.6 mm wide, white, basifixed, with white anther sacs, pollen white; staminodes 3, opposite the petals, longer, slightly epipetalous, filaments 1.5-3.4 mm long, white, glabrous, slightly bent in the middle (Fig. 21) or S-shaped above the middle (Fig. 22), anthers 0.3-1.0 mm long, 0.4-0.9 mm wide, broadly basifixed, not versatile, connective yellow, inconspicuous, broadened with anther sacs parallel, or C-shaped with the anther sacs divergent, pollen white or yellow; ovary 0.5-1.0 mm long, 0.4-0.9 mm in diam., white, glabrous, style 0.2-0.4 mm long, stigma simple. Capsule globose, 2.0-3.3 mm long, brown or green, glabrous; seeds one per locule, ovate with the broad end and two sides rolled inward (involute) which results in concavities on three sides due to the inrolling, these concavities alternating with three convexities where the edge is not rolled

(turned), involute margins nearly touching and covering the protruding embryotega (Fig. 72), testa black, areolate, hilum linear (Fig. 73).

Chromosome number: $n=16$.

Distribution and habitat: México, in the states of Sonora, Sinaloa, Jalisco, Michoacán, Guerrero, and Puebla; at low elevations, 50 to ca. 1400 m. The plants grow in relatively dry areas with seasonal rainfall; the vegetation is characterized as thorn scrub; candelabra cacti usually are abundant. The soil in which these plants grow is brown or black loam with abundant humus but in dry stream beds it is loose due to the presence of sand and gravel.

Flowering: Plants flower in August, September and October. The flowers commonly open about 8:00 AM and close about noon.

REPRESENTATIVE SPECIMENS

**México.** SONORA: Chorijoa, Río Mayo, 22 Aug. 1935, *Gentry* 1598 (ARIZ, F). SINALOA: El monte, Los Labrados, 50 m., 15 Oct. 1926, *Mexia* 927 (UC, US). JALISCO: near Bolaños, Sept. 1897, *Rose* 2891 (GH, K, NY, US). MICHOACAN: Apatzingán, Dist. Apatzingán, 300 m., 19 Aug. 1938, *Hinton et al.* 12051 (GH, K, NY). MEXICO: Cerro de Los Capulines, Palmar Chico, 1100 m., 26 Aug. 1954, *Matuda* 31337 (MEXU). GUERRERO: Coyuca-Chacamerito, Dist. Coyuca, 19 Sept. 1934, *Hinton et al.* 6620 (GH, K, MICH, NY, US). PUEBLA: km. 232.5 of Hwy. 190, ca. 4 km. west of Río Atoyac, 1370 (1040)m., 9 Sept. 1967, *Handlos* 403 (BH).

*Tripogandra palmeri* is unique because the seeds are borne one per locule; at anthesis there are two ovules in each locule but the lower one always aborts. The seeds are further unique in that the margins are involute on three sides, rolling up in such a fashion that they nearly cover the protuberant embryotega.

An interesting pattern of morphological variation can be seen in the 20 collections I have examined. All 15 collections made north of Guerrero or north of 18° 30′ N latitude have narrowly ovate, nearly glabrous leaves, few flowers per inflorescence, a narrow connective, parallel

anther sacs and epipetalous filaments which are bent slightly in the middle. The five collections made south of 18° 30′ N in the southern drainage area of the Río Balsas-Río Mexcala have larger, more nearly ovate leaves which are commonly pilose on both surfaces (though some plants have leaves which are glabrous ventrally except for the mid-vein), there are more flowers per inflorescence, the connective is C-shaped, anther sacs are divergent, and the epipetalous filaments are S-shaped. Both of these forms were collected in the drainage basin of the Río Balsas. As the plants are annuals and self-pollination is probably the most common breeding pattern, variation in local populations would be expected to be small. Since the two morphological types occur in different geographical areas they might be recognized as subspecies. Because so few collections have been made. a more complex pattern of variation may emerge in the future and I decline, therefore, to introduce a new name. However, the linear distance covered by this limited number of collections is rather extensive, 1140 and 360 kilometers for the northern and southern forms respectively. Further studies and collections should be made throughout the range of this species and especially in the Guerrero-Michoacán border area in the region of Presa del Infiernillo and to the east which is the area of presumed contact between the two forms.

16. **Tripogandra purpurascens** (Schauer) Handlos, Baileya 17:33. 1970.

*Tradescantia purpurascens* Schauer in Nees ab Esenbeck and Schauer, Linnaea 19:700. 1847. HOLOTYPE: Mejico, *Aschenborn* 493 (B!).

Plants annual; stem erect, to 73 cm tall, branched or unbranched, lower portion sometimes decumbent, then rooting at the nodes; internodes to 12.4 cm long, glabrous or with scattered capitate hairs, a line of uniseriate hairs always present. Leaves narrowly ovate; blades to 8.0 cm long, to 2.7 cm wide, complicate, with base rounded or sometimes cuneate, glabrous on both sides (rarely with a

few hairs dorsally), margin ciliate, apex acute; sheaths to 12.5 mm long, to 8.0 mm in diam., villous or with a few long hairs at the orifice, a line of uniseriate hairs extending down the side opposite the blade, otherwise glabrous or with scattered capitate hairs to 1 mm long. Inflorescences of 1-5 double cincinni borne terminally and in the axils of the upper leaves; peduncles to 14.1 cm long, always with scattered capitate hairs and with or without 1-2 lines of uniseriate hairs extending down the sides; double cincinni with up to 26 buds, flowers and/or fruits; pedicels to 7.0 mm long, reflexed in fruit, pilose or with scattered capitate hairs (Fig. 1); bracts at the base of each pedicel pilose or with scattered capitate hairs, margin partly, wholly, or not at all ciliate. Flowers pink or rarely white; sepals ovate-cymbiform, to 5.0 mm long, to 2.8 mm wide, green or with a red tip and/or base and/or margin, pilose or with scattered capitate hairs (Fig. 1) to 1 mm long, margin hyaline, apex more or less acute; petals obovate, to 6.0 (-8.6) mm long, to 4.8 mm wide, base cuneate, apex acuminate or irregularly indented; stamens in two whorls, the outer whorl shorter, filaments to 1.8 mm long, pink in the middle, white on the ends, bearing a tuft of moniliform hairs on the mid-portion of the dorsal side (Fig. 5), anthers 0.4-1.1 mm long, 0.4-1.2 mm wide, white with a purple line around the open sac, basifixed, anther sacs more or less parallel, pollen white; inner whorl of stamens longer, to 5.5 mm long, pink in the middle and white on both ends, glabrous, bent in an open S-shape and slightly expanded in the upper portion (Fig. 18), anthers 0.5-1.1 mm long, 0.5-1.4 mm wide, basifixed, connective inflated, bent, yellow, anther sacs divergent or nearly parallel through bending of the connective, pollen cream-colored; ovary 0.8-1.4 mm long, 0.6-1.4 mm in diam., green, glabrous, style 0.3-0.5 mm long, stigma simple, capitellate or capitate. Capsule obovate, 2.2-3.5 mm long, 1.8-4.0 mm in diam., green to light brown, glabrous; seeds two per locule, triangular, 1.2-1.8 (-2.1) mm long, brown, testa ribbed areolate (Figs. 50, 51, 54, 55), hilum punctiform (Figs. 51, 55).

In the past, plants of this species were identified as *Tripogandra disgrega*. As noted earlier, the holotype for *T. disgrega* is unmistakeable so another name must be applied to these plants. The next available name is *Tradescantia purpurascens* Schauer. The description accords well with *Aschenborn* 493 in the Berlin herbarium and because I have seen no other specimen I consider this to be the holotype. The description does not mention the stamens or seeds but dissection of the flowers proved the specimen to be *Tripogandra*. This specimen was seen by C. B. Clarke, annotated by him, and is cited apparently as "*Amberbeau* 493", under his description of *Tradescantia disgrega*. Several specimens of *T. purpurascens* were listed by him under *T. amplexicaulis*. He apparently did not have clear concepts of the species *T. amplexicaulis* and *T. disgrega*. He does not include the name *T. purpurascens* in his list of synonyms for *T. disgrega* or any other species. This omission is surprising considering the number of manuscript names that are included as synonyms in the various species he dealt with.

The separation of and differences between *Tripogandra disgrega* and *T. purpurascens* are discussed under the former species.

*Tripogandra purpurascens* is found in every country from México to Panamá, is absent from most of South America and occurs again in southern Bolivia and northern Argentina. This outlier is morphologically recognizeable by the presence of scattered capitate hairs on all the internodes. I recognize these plants as *T. purpurascens* subspecies *australis*. In all other respects it seems to be identical with the typical element of the species.

16a. **Tripogandra purpurascens** (Schauer) Handlos subsp. **purpurascens.**

*Tradescantia minuta* Clarke in DC., Monographiae Phanerogamarum 3:307. 1881. TYPE: **México.** *Uhde* 141a (Holotype, B!; isotype, L!).

*Tradescantia parvula* Brandegee, Univ. Calif. Publ. Bot. 6:51. 1914. TYPE: **México.** PUEBLA: Boca del Monte, Oct. 1913, *Purpus* 6486 (Holotype, UC!; isotypes, BM!, F!, GH!, MO!, NY!).

*Descantaria minuta* (Clarke) Brückner, Notizbl. Bot. Gart. Berlin-Dahlem 10:56. 1927.

*Tripogandra minuta* (Clarke) Woodson, Ann. Missouri Bot. Gard. 29:153. 1942.

Lower internodes glabrous except for a line of uniseriate hairs extending down one side, rarely the upper internodes with scattered capitate hairs.

Chromosome number: $n=16$.

Vernacular name: matlale fide Kerber, México.

Distribution and habitat: México, Guatemala, Honduras, El Salvador, Nicaragua, Costa Rica, Panamá; in seasonal stream beds or as a weed in cultivated fields at elevations from 990 to 2500 meters.

Flowering: In México flowering occurs from August to December while in Guatemala it occurs from September to January and occasionally in April and June. In the remainder of Central America flowering plants may be found from September to November in Honduras and El Salvador, December to February in Nicaragua, July to December in Costa Rica, and December to March in Panamá.

Flowers open about 10:00 AM and close about 12:45 PM.

REPRESENTATIVE SPECIMENS

**México.** CHIHUAHUA: base of Sierra Madre, 3 Oct. 1888, *Pringle* 1680 (BM, BR, L, M, UC). SINALOA: km. 1184 of Hwy. 40, 1.7 km. above Potrerillos, 1600 m., 15 Oct. 1967, *Handlos* 464 (BH). DURANGO: at the city of Durango and vicinity, 6297 ft., Apr.-Nov. 1896, *Palmer* 646 (BM, C, F, GH, MO, NY, US). ZACATECAS: Sierra de los Morones, near Plateado, Sept. 1897, *Rose* 2713 (NY, US). SAN LUIS POTOSI: Alvarez, 5-10 Sept. 1902, *Palmer* 139 (GH, MO, NY, US). NAYARIT: vicinity of Jalisco, 10 Nov. 1925, *Ferris* 5893 (DS, US). JALISCO: about 11 miles southeast of Lagos de Moreno, near highway to León,

1900 m., 7 Sept. 1952, *McVaugh* 12829 (MICH). HIDALGO: lower slopes of Mt. Leña, west of Leña Station (FCNM), Mun. Nopala, Dist. Huichapan, 2500 m., 10 Oct. 1946, *Moore, Jr.* 1441 (BH, GH). VERACRUZ: La Luz pr. Córdoba, 7 Oct. 1882, *Kerber* 90 (BM, C, GOET, M, US). MICHOACAN: sparsely to densely vegetated slopes of lava flow east of San Juan Nuevo, ca. 8 km. south of Uruapan, 6100 ft., 11-15 Oct. 1961, *King & Soderstrom* 4719 (MICH, NY, UC, US). MEXICO: Ixtapan, Dist. Temascaltepec, 1000 m., 19 Oct. 1932, *Hinton* 2231 (F, GH, MO, NY, US). DISTRITO FEDERAL: Mt. Guadalupe prés México, 24 Aug. 1865-66, *Bourgeau* 888 (BR, C, GH, K, L, M, NY, US). MORELOS: Las Guacamayas, Cuernavaca, 1800 m., 5 Aug. 1966, *Rebolledo V.* (MICH, MSC). PUEBLA: Laguna San Baltasar, vicinity of Puebla, 2135 m., 20 Sept. 1906, *Arsène* 327 (US). GUERRERO: Pilas, Dist. Mina, 1000 m., 24 Sept. 1937, *Hinton* 10712 (BR, GH, NY, POM, US). OAXACA: Santiago Huitzo, 5500 ft., 22 Oct. 1894, *Smith* 231 (GH). CHIAPAS: Milpa on the north edge of San Cristóbal las Casas, Municipio of San Cristóbal, 7100 ft., 25 Sept. 1965, *Breedlove* 12430 (DS, F, MICH). **Guatemala.** HUEHUETENANGO: 3 km. south of Huehuetenango, 1800 m., 30 Nov. 1962, *Williams, Molina R. & Williams* 22117 (F, NY). QUICHE: mts. east of Quiché, 2020 m., 20 Nov.-4 Dec. 1940, *Grant* 656 (F, GH p.p., MICH p.p.). SAN MARCOS: San Marcos, 2000 m., 17 June 1882, *Lehmann* 1609 (BM, US). QUEZALTENANGO: Quezaltenango, Sept. 1876, *Bernoulli & Cario* 781 (GOET). SOLOLA: mountain slopes above Lake Atitlán, about 3-5 km. west of Panajachel, 2100 m., 6-7 Dec. 1963, *Williams, Molina R. & Williams* 25378 (F, NY). CHIMALTENANGO: near Finca La Alameda, near Chimaltenango, 1830 m., 7 Dec. 1938, *Standley* 59029 (F). GUATEMALA: Finca Bretaña, road between Guatemala and Fiscal, 1200 m., 12 Dec. 1938, *Standley* 59667 (F). JALAPA: Laguna de Ayarza, 8000 ft., Sept. 1892, *Heyde & Lux* 3885 (GH, US). CHIQUIMULA: Volcán Quezaltepeque, 3-4 miles northeast of Quezaltepeque, 1500-2000 m., 8 Nov. 1939, *Steyermark* 31502 (F). SANTA ROSA: Laguna Los Pinos, below Cerro Redondo, 25 Oct. 1942, *Steyermark* 52168 (F, MO). **Honduras.** MORAZAN: Guamiles sobre las faldas noroeste de la Mt. Uyuca, cerca de Las Flores, drainage of the Río Yeguare, 1600 m., 20 Oct. 1948, *Molina R.* 1273 (F, GH, MO). **El Salvador.** LA LIBERTAD: rim of Volcán San Salvador, 1800 m., 22 Sept. 1946, *Williams & Molina R.* 10622 (GH, MICH, MO). **Nicaragua.** JINOTEGA: road to La Fundadora, entering at km. 142 from Managua, region of Santa María de Ostuma, 1400 m., 7 Dec. 1958, *Hawkes, Hjerting & Lester* 2197 (C, K). MATAGALPA: road to La Fundadora, cloud forest area north of Sta. María de Ostuma, Cordillera Central de Nicaragua, 1300-1500 m., Feb. 1963, *Williams, Molina R. & Williams* 24949 (F, NY). **Costa Rica.** ALAJUELA: Clairiere au rancho de l'Achiote (Poas), 2200 m., Nov. 1896, *Tonduz* 10765 (BR, US). SAN JOSE:

à San José, 1135 m., Oct. 1890, *Tonduz* 3047 (BR, M, US). CARTAGO: Cartago, 4250 ft., Nov. 1887, *Cooper* 5962 (GH, NY, US). **Panamá.** CHIRIQUI: Alto Lino, vicinity of El Boquete, 990 m., 3 Feb.-15 Mar. 1938, *Maurice* 743 (US).

The species *Tradescantia minuta* has confused various authors — Matuda (1956) for example, includes specimens of *Leptorhoeo* and *Murdannia* in his circumscription of it. Clarke's original description states that the staminal filaments are glabrous. One assumes from this that all six are glabrous and if one studies the dissected flower present on the holotype (*Uhde* 141a), this seems correct. The problem arises from the fact that the dissected flower is an immature one and the hairs on the filaments have not yet developed. An examination of flowers well past anthesis with nearly mature capsules reveals that the short filaments of the outer whorl are bearded and the longer filaments of the inner whorl are glabrous. The remainder of the description seems correct. *Uhde* 141a seems to represent a very reduced (depauperate) form of *Tripogandra purpurascens* subsp. *purpurascens*. The corrected observation of the presence of bearded filaments leaves no character by which to distinguish this material as a different species.

As Clarke erred in describing his new species with glabrous filaments, so T. S. Brandegee erred in describing the six filaments of his new species, *Tradescantia parvula*, as bearded. Again, a closer examination of the specimens reveals that the three short filaments are bearded but the three longer ones are glabrous. *Tradescantia parvula* represents another depauperate form of *Tripogandra purpurascens* subsp. *purpurascens*. Plants which have a strictly annual habit seem to be able to flower and produce seeds when of a very small size and with very few leaves. On the other hand some plants seem capable of producing long stems. In México, plants of *Handlos* 160 flowered at a height of 12.5 cm, but when seeds of these plants were grown in the greenhouse in Ithaca, N.Y., the seedlings reached a height of over a meter before flowering.

Throughout México this subspecies is relatively uniform in size considering the plasticity of annuals. The presence of one or two lines of uniseriate hairs on the peduncle is a sporadic character over much of México but in southern México and in Central America it becomes more common and is used as a key character by Standley and Steyermark in their Flora of Guatemala. There is still variability — some plants lack the line — but the frequency of occurrence is much higher than in México north of Chiapas.

The colonizing and weedy propensities of *Tripogandra purpurascens* subsp. *purpurascens* should be noted. Plants of this subspecies probably existed in stream beds and naturally disturbed areas such as those around volcanoes prior to man's invasion of the ecosystem. Often I have seen *T. purpurascens* subsp. *purpurascens* in seasonal stream beds and on August 19, 1965, on a trip to the volcano of Paricutín, I found plants of subsp. *purpurascens* growing within ten meters of the edge of a lava flow. The area had been covered with a layer of volcanic ash but the plants were growing, flowering and producing seeds under these conditions. Volcanic activity has occurred extensively and for a long period of time in México. Clausen (1959) has designated the central, volcanically active area of México as the Trans-Mexican Volcanic Belt. The weedy habit in this species probably could have existed before the advent of man and his disturbances of the natural vegetation but man must be credited for opening additional areas for colonization by this species and allowing it to become the most common species of *Tripogandra* in México.

16b. **Tripogandra purpurascens** (Schauer) Handlos subsp. **australis** Handlos, *subsp. nov.* TYPE: **Bolivia.** Toldos bei Bermejo, 1850 m., 26 Nov. 1903, *Fiebrig* 2221 (Holotype, GH!; isotypes, K!, L!, M!).

Illustrations: Bacigalupo, Darwiniana 13:402. 1967, Figs. 2, 5a-g, as *T. disgrega*.

*Internodia* pilis capitatis, dispersis pubescentia. In Bolivia australi et Argentina boreali indigena.

Internodes all with scattered capitate hairs and a line of uniseriate hairs.

Distribution and habitat: southern Bolivia and northern Argentina; in wet wooded areas or as a weed in disturbed places at elevations from 450 to 1850 meters.

Flowering: In January, February and March in Argentina.

REPRESENTATIVE SPECIMENS

**Bolivia.** *Fiebrig* 2221 (GH, K, L, M). **Argentina.** SALTA: Dept. Gen. M. Güemes, camino de La Cornisa, between Jujuy and Salta, at km. 1648.9, 1480 m., 18 Mar. 1966, *Hawkes, Hjerting & Rahn* 3909 (C). TUCUMAN: Cuesta del Garabatal, Sierra de Ende, Jan. 1874, *Lorentz & Hieronymus* 875 (CORD, E, F, GOET).

17. **Tripogandra saxicola** (Greenman) Woodson, Ann. Missouri Bot. Gard. 29:154. 1942.

*Tradescantia saxicola* Greenman, Proc. Amer. Acad. Arts 39:70. 1903. TYPE: **México.** GUERRERO: Iguala Cañon, 14 Sept. 1900, *Pringle* 9270 (Holotype, GH!; isotype, VT!).

*Descantaria saxicola* (Greenman) Brückner, Notizbl. Bot. Gart. Berlin-Dahlem 10:56. 1927.

Plants annual, erect or with the lower portion decumbent, rooting at lower nodes; stems to 31 cm long, unbranched to branched at every node; internodes 0.1-7.4 cm long, green or purplish-tinged at the base of the plant, a band of uniseriate hairs extending from the sheath above to the node below, otherwise variously glabrous to pilose. Leaves narrowly ovate to ovate; blades 1.0-7.4 cm long, 0.1-2.0 cm wide, glabrous dorsally, ventrally variously glabrous, pilose along the midvein, or pilose over the entire surface, base cuneate or truncate, margin ciliate; sheaths 1.0-5.0 mm long, 1.2-5.0 mm in diam. when dry, villous at the orifice, a line of uniseriate hairs extending down the side opposite the blade, otherwise glabrous or with a few scattered uniseriate hairs. Inflorescences few, borne terminally and in

the upper leaf axils; peduncles to 5.9 cm long, or so reduced that the double cincinni appear sessile, glabrous except for one or two lines of uniseriate hairs extending down the side; double cincinni with 1-10 flowers; pedicels 2.2-5.5 mm long, 0.3-0.6 mm in diam., pilose to densely pilose (Fig. 2), reflexed in fruit; bracts at the base of each pedicel usually ciliate. Flowers white; sepals ovate-cymbiform, 2.0-4.6 mm long, 1.3-2.4 mm wide, green, sparingly pilose to densely pilose, apex acute to obtuse, margin entire, hyaline; petals elliptic-ovate, ca. 2.5-5.8 mm long, ca. 2.0-4.5 mm wide, tapering at the base, apex obtuse; stamens 6, in two whorls, those of the outer whorl shorter, filaments 1.0-1.6 mm long, glabrous (Fig. 12), anthers 0.6-1.0 mm long, 0.3-0.7 mm wide, basifixed, versatile with parallel white anther sacs which are longer than the gibbous white connective, pollen white; stamens of the inner whorl longer, slightly epipetalous, filaments 2.0-4.5 mm long, bearded on the dorsal distal surface, with white moniliform hairs (Fig. 20), connective U-shaped, 0.3-0.7 mm long, 0.3-0.9 mm wide, yellow, dorsifixed, versatile, with yellow divergent anther sacs, pollen yellow; ovary 0.7-1.1 mm long, 0.6-1.1 mm in diam., green, glabrous, style 0.2-0.4 mm long, stigma capitellate. Capsule glabrous, brown, 2.5-2.7 mm long; seeds usually 6, 0.9-1.3 mm long, triangular or triangular with a notch in one end, with 2-3 furrows on the hilar side forming 3-4 lobes, brown to gray-brown, surface areolate (Fig. 56), hilum punctiform (Fig. 57) to elliptical.

Chromosome number: $n=21$.

Distribution and habitat: in the states of Guerrero, Morelos, and Puebla, México; in thin soil in rocky areas or under shrubs at elevations from ca. 840 to 1500 m.

Flowering: Flowers open about 3:00 PM and close about 5:00 PM. Therefore, this species appears to be unique among the Mexican *Tripogandra* species because it is the only one in which the flowers open in the afternoon; all other species flower in the morning even though blossoms may not close until afternoon.

REPRESENTATIVE SPECIMENS

**México.** MORELOS: Yautepec, near Cuernavaca, 22 Oct. 1902, *Pringle* (VT). PUEBLA: km. 216 on road to Oaxaca, Hwy. 190, about 16 km. SE of Izúcar de Matamoros, 30 Aug. 1965, *Handlos* 215 (BH). GUERRERO: Cañon del Mano, along railroad tracks north of Iguala, ca. 3 km. north of El Naranjo, ca. 840 m., 13 Sept. 1967, *Handlos* 418 (BH).

The origin of the annual habit may be illustrated by the growth cycle of *Tripogandra saxicola*. In México this species acts as an annual. All collections seem to be of the current season's growth judging from the presence of juvenile leaves at the base of the plant and the absence of old trailing stems and interconnections between plants. In the greenhouse, however, plants of *Handlos* 215 have functioned as perennials. The plants lose most of their leaves during the winter, though flowering continues, and some of the stems remain green. In May and June, vegetative shoots are produced, the plants grow vigorously, rooting at the nodes, and vegetative reproduction is very easy. However, not all collections react in this fashion. Plants of *Handlos* 415 acted as annuals in the greenhouse and died completely after flowering and producing seeds in 1967 and 1968. This behavior seems significant as it indicates that both the annual and perennial habit may exist within some species. With the extinction of all the perennial plants the species would appear strictly annual. The presence of annual and perennial populations also occurs in *Tripogandra serrulata* and may indicate that the annual habit has arisen independently several times within the genus and that some annual species may be of recent origin.

The collections *Handlos* 198 and 419 merit mention because these plants were collected in the same area in two different years. In 1965, when *Handlos* 198 was collected, the area was covered with large shrubs and small trees and had received enough rain so the ground was moist and water dripped from the ledges. Plants reached a maximum height of 31 centimeters and were found only

after crawling under and through the bushes. Two years later I found the whole area cut over, apparently for firewood, with very little brush left. It was then possible to walk and climb over the rocks with little interference from the remaining woody vegetation. The plants collected as *Handlos* 419 were wilted, what little soil was left was exceedingly dry, and the few individuals which were found reached a maximum height of only 15 centimeters. This information not only gives an impression of how much variation may occur in an area from year to year but it also gives us a glimpse of the fate of the plants in this area. First, there is a diminution of plant size; second, there is a reduction in population size, and lastly, extinction is probable as the soil is gradually washed away from the rocky ledges and weedy plants which are better competitors grow in the alluvium deposited at the cliff bases.

18. **Tripogandra serrulata** (Vahl) Handlos, Baileya 17:33. 1970.

*Commelina serrulata* Vahl, Eclogae Americanae 2:4. 1798. HOLOTYPE: *Ryan* (C!).

?*Tradescantia elongata* Meyer, Primitae Florae Essequeboensis . . . 146. 1818. HOLOTYPE: apparently lost.

*Tradescantia congesta* Martens & Galeotti, Bull. Acad. Bruxelles 4(2):377. 1842. HOLOTYPE: **México.** VERACRUZ: Mirador, 3000 ft., June-Oct. 1840, *Galeotti* 4949 (BR!).

*Tradescantia balbisii* Kunth, Enumeratio Plantarum 4:97. 1843. TYPE: Portorico, 1834, *Balbis* (Holotype, B!; isotype, B!).

*Tradescantia schlechtendalii* Kunth, Enumeratio Plantarum 4:94. 1843. TYPE: **México.** Hacienda de la Laguna, Oct. 1828, *Schiede* 972 (Holotype, B!; isotype, HAL!).

*Tradescantia schomburgkiana* Kunth, Enumeratio Plantarum 4:663. 1843. TYPE: Guiana Angl., 1842, *Schomburgk* 189 (Holotype, B!; isotype, K!).

*Tradescantia guianensis* Miquel, Linnaea 18:374. 1845 ('1844'). TYPE: **Surinam.** *Focke* 400 (Holotype, U!; isotype, GH!).

*Descantaria ?balbisii* Hasskarl ex Clarke in DC., Monographiae Phanerogamarum 3:303. 1881, *nom. nud. pro syn.*

*Descantaria schlechtendalii* Hasskarl ex Clarke in DC., Monographiae Phanerogamarum 3:304. 1881, *nom. nud. pro syn.*

*Heterachtia gaudichaudiana* Hasskarl ex Clarke in DC., Monographiae Phanerogamarum 3:303. 1881, *nom. nud. pro syn.*

*Tradescantia cumanensis β glabrior* Clarke in DC., Monographiae Phanerogamarum 3:306. 1881. TYPE: **Nicaragua.** Chontales, 1867-8, *Tate* 452 (Holotype, K!; isotype, BM!).

*Tradescantia elongata δ schlechtendalii* (Kunth) Clarke in DC., Monographiae Phanerogamarum 3:304. 1881.

?*Descantaria elongata* (Meyer) Brückner, Notizbl. Bot. Gart. Berlin-Dahlem 10:56. 1927.

?*Tripogandra elongata* (Meyer) Woodson, Ann. Missouri Bot. Gard. 29:152. 1942.

*Tripogandra cumanensis* f. *glabrior* (Clarke) Standley & Steyermark, Fieldiana: Bot. 24(3):36. 1952.

Illustrations: Standley and Steyermark, Fieldiana: Bot. 24(3):39, 1952, Fig. 9, a line drawing of a flower and upper part of the plant. The position of the stamens is incorrectly shown in the open flower and misplaced in the flower drawing.

Plants perennial, decumbent at the base, rooting at nodes, flowering stems erect; stems to 1.14 m long, branching irregularly; internodes to 14.1 cm long, glabrous except for a line of uniseriate hairs extending down the side from the sheath above (Fig. 4). Leaves narrowly ovate, occasionally ovate; blades to 13.2 cm long,

to 2.7 cm wide, glabrous to pilose dorsally, rarely with a line of hairs along the midvein, glabrous to sparingly pilose ventrally, often with a line of uniseriate hairs along the midvein, base oblique, margin ciliate, apex acute; sheaths to 2.1 cm long, to 1.2 cm in diam., villous at the orifice, a line of uniseriate hairs extending down the side opposite the blade (Fig. 4), otherwise variously glabrous or the uppermost occasionally with scattered uniseriate hairs or pilose. Inflorescences composed of 1-13 double cincinni borne terminally and in the axils of the upper 1-4 leaves; peduncles 0.4-5.1 (-6.7) cm long, glabrous or with 1-2 lines of uniseriate hairs extending down the sides; double cincinni with up to 17 buds, flowers and/or fruits; pedicels 0.7-5.0 mm long, 0.5-0.7 mm in diam., reflexed in fruit, glabrous to sparingly pilose (Fig. 3), hairs capitate; bracts at the base of each pedicel glabrous, margin entire, ciliate, or with a few scattered hairs. Flowers white or pink (Fig. 16); sepals ovate, 2.5-4.6 mm long, 1.3-2.7 mm wide, glabrous to sparingly pilose (Fig. 3), hairs capitate, margin hyaline, apex acute to obtuse; petals ovate-elliptic, 3.5-6.2 mm long, 2.3-4.3 mm wide, base cuneate, apex rounded; stamens 6 in two whorls, the outer shorter, filaments 1.0-1.5 mm long, white, glabrous or with a few (1-3) moniliform hairs, anthers 0.5-1.0 mm long, 0.4-1.0 mm wide, anther sacs parallel, connective inconspicuous, pollen white; stamens of the inner whorl longer, filaments 2.7-4.5 mm long, white, bent in an open S-shape, bearded with moniliform hairs in the upper half (Fig. 19), anthers 0.4-0.8 mm long, 0.5-1.0 mm wide, basifixed, connective elongate and narrow, anther sacs divergent, yellow, pollen yellow; ovary 0.6-1.3 mm long, 0.5-1.0 mm in diam., white, glabrous, style 0.1-0.3 mm long, stigma capitate, weakly 3-lobed. Capsule elliptical, 2.0-2.8 mm long, 1.5-2.5 mm in diam., light brown, glabrous; seeds usually 2 per locule, rounded triangular, 0.9-1.5 mm long, gray or brownish-gray, testa reticulate, reticulations lighter in color (Fig. 38), hilum punctiform (Fig. 39).

Chromosome number: $n=16$, 24.

Vernacular names: suelda fide Bro. Daniel, Colombia; siempre viva fide Archer, Colombia; palm grass (Barbadian) fide Standley, Panamá; matalin, shiú fide Martínez-Calderón, México; yerva del poyo fide Curtiss, México.

Distribution and habitat: central México, south to Panamá, Colombia, Ecuador, Perú, Venezuela, Guyana, Surinam, and the Caribbean islands; from sea level to about 1500 m. Most specimens with altitudinal information are from intermediate to low elevations. Two records are exceptions. Matuda reports 2500 meters for one location in México, while Heyde and Lux reported 8000 feet for a collection in Guatemala. These reports should be investigated further.

Flowering: in México from January to December; in Guatemala from August to January and March, May, and July; in British Honduras from October to February and April; in Honduras from November to March and May, June, August, and September; in El Salvador from December to April and July; in Nicaragua in April and December; in Costa Rica in every month except January; in Panamá in every month of the year; in Colombia in February, March, April, May, June, August, October, November, and December; in Ecuador in May and August; and in Perú in April.

Flowers open in the morning about 9:00 AM and close about 2:30 PM.

REPRESENTATIVE SPECIMENS

**México.** SAN LUIS POTOSI: Tamazunchale, 250 ft., 5 Aug. 1937, *Fisher* (MO, NY, US). HIDALGO: wooded slopes between Calnali and Huazalingo, Dist. Huejutla, 29 May 1947, *Moore, Jr.* 3016 (BH). VERACRUZ: Orizaba, Mt. Orizaba, 4000 ft., 29 Aug. 1891, *Seaton* 29 (F, GH, NY, US). DISTRITO FEDERAL: Monte Guadalupe près México, 24 Aug. 1865, *Bourgeau* 888 (GH). MORELOS: Cuernavaca, 29 Oct. 1903, *Holway* 5261 (GH). PUEBLA: near Metlaltoyuca, 800 ft., 31 Jan. 1898, *Goldman* 49 (US). OAXACA: Yaveo, Arroyo del Perrico, Dist. Choapam, 475 m., 15 Mar. 1938, *Mexia* 9153 (F, GH, MO, NY, U, UC, US). CHIAPAS: Escuintla, Nov.-Dec. 1937, *Matuda* 2176 (F, GH, MICH, NY, UC). **Guatemala.** ALTA VERAPAZ: Finca Mocca, 3200 ft., 5 Jan. 1920, *Johnson* 169 (NY, US). IZABAL: vicinity of Quiriguá,

75-225 m., 15-31 May 1922, *Standley* 24165 (GH, NY, US). SAN MARCOS: river 5 mi. W of Malacatan, 400 m., 20 Nov. 1940, *Grant* 566 (F, GH). QUEZALTENANGO: Finca Pireneos, below Santa María de Jesús, 1350-1380 m., 11 Mar. 1939, *Standley* 68347 (F, MICH). SACATEPEQUEZ: Ciudad Vieja, Mar. 1915, *Tejada* 343 (US). GUATEMALA: Breñas y seta cerca de Guatemala, 1400 m., July 1921, *Tonduz* 669 (US). JALAPA: Laguna de Ayarza, 8000 ft., Oct. 1892, *Heyde & Lux* 3882 (GH, K, M, US). ZACAPA: Gualán, 420 ft., 20 Jan. 1905, *Deam* 404 (GH, MICH). RETALHULEU: San Felipe, 13 Jan. 1917, *Holway* 710 (US). SUCHITEPEQUEZ: Chojoja p. Mazatenango, Sept. 1867, *Bernoulli* 469 (BR, NY). ESCUINTLA: Escuintla, 1100 ft., Mar. 1890, *Donnell-Smith* 2220 (GH, M, US). SANTA ROSA: Río María Linda, 3000 ft., Sept. 1893, *Heyde & Lux* 6251 (GH, US). SAN MARCOS: Cangutz, 1140 m., 31 July 1922, *Galas* 11 (US). **British Honduras.** Gracie Rock, Sibun River, 15 April 1935, *Gentle* 1594 (F, GH, MICH, MO, NY, US). **Honduras.** SANTA BARBARA: Río Permejo, 600 ft., Dec. 1888, *Thieme* 5532 (GH, US). CORTES: in ravine near Lake Yojoa, Agua Azul, 630 m., 28 Dec. 1946, *Williams & Molina R.* 11411 (BH, GH, MICH, MO, UC). COMAYAGUA: Rittenhouse's hacienda near Siguatepeque, 1050 m., 30 June 1936, *Yuncker, Dawson & Youse* 5527 (F, GH, MICH, MO, U). ATLANTIDA: Ceiba, 26 Sept. 1916, *Dyer* A94 (US). YORO: Farm 39 of the Tela Railroad Company, Guaymas Dist., 30 m., 2 Feb. 1928, *Standley* 55489 (US). OLANCHO: a la orilla de la quebrada cerca de El Plomo, Valle Catacamas, 300 m., 19 Nov. 1963, *Molina R.* 13290 (G, NY). LEMPIRA: faldas de Montaña Puca cerca de Los Cuábanos, 1300 m., 25 Sept. 1963, *Molina R.* 12956 (F, NY). MORAZAN: along Santa Clara Creek, drainage of the Río Yeguare, 850 m., 6 Aug. 1949, *Williams & Molina R.* 15865 (GH, US). EL PARAISO: Montaña entre Cifuentes y El Urraco, 900 m., 15 Mar. 1963, *Molina R.* 11428 (F, NY, US). **El Salvador.** AHUACHAPAN: vicinity of Ahuachapán, 800-1000 m., 9-27 Jan. 1922, *Standley* 19838 (GH, NY, US). SONSONATE: Finca Chilata, 26, 27 Dec. 1921, *Standley* 19311 (GH, NY, US). LA LIBERTAD: vicinity of Santa Tecla, 790-950 m., 10 Apr. 1922, *Standley* 23054 (US). SAN SALVADOR: San Salvador, July 1922, *Calderón* 913 (GH, MO, NY, US). LA PAZ: Zacatecoluca, Mar. 1922, *Calderón* 303 (GH, NY, US). SAN VICENTE: vicinity of San Vicente, 350-500 m., 2-11 Mar. 1922, *Standley* 21727 (GH, MO, NY, US). **Nicaragua.** JINOTEGA: road to La Fundadora, entering at km. 142 from Managua, region of Santa María de Ostuma, 1400 m., 7 Dec. 1958. *Hawkes, Hjerting & Lester* 2198 (C). CHONTALES: slopes of Mt. Mombacho, near Grenada, 460 m., 18 Dec. 1940-9 Feb. 1941, *Grant* 787 (F, GH, MICH). ZELAYA: vicinity of El Recreo, on Río Mico, ca. 30 m., 23 Apr.-14 May 1949, *Standley* 19091 (F). **Costa Rica.** ALAJUELA: Villa Quesada, Canton San Carlos, 825 m., 10 Mar. 1940, *Smith* p2574 (F, MICH, MO). SAN JOSE: vicinity of

El General, 915 m., Feb. 1936, *Skutch* 2602 (GH, MICH, MO, NY, US). CARTAGO: Angostura, 19 June 1874, *Kuntze* 2050 (NY). LIMON: Jiménez, Llanos de Santa Clara, 650 ft., Apr. 1894, *Donnell-Smith* 4976 (GH, K, US). **Panamá.** BOCAS DEL TORO: Bocas del Toro, 6 Nov. 1920, *Carleton* 71 (GH, NY, US). CHIRIQUI: Boquete, Boquete Dist., 3800 ft., 17 May 1938, *Davidson* 665 (F, GH, MO, US). COCLE: Lower Río Anton, vicinity of El Valle De Anton, 800-1000 (600) m., 30 Dec. 1936, *Allen* 111 (GH, MO, PH). CANAL ZONE: ruins of fort, Fort San Lorenzo, Fort Sherman Military Reservation, 14 June 1923, *Maxon & Valentine* 7018 (C, GH, US). PANAMA: Tumba Muerto Road, near Panamá, 6 Jan. 1924, *Standley* 29717 (C, US). DARIEN: vicinity of Boca de Cupe, ca. 40 m., 5 Oct. 1938, *Allen* 890 (F, GH, MO, NY, US). SAN BLAS: Perme, 24 Apr. 1933, *Cooper III* 253 (NY, US). **Venezuela.** CARABOBO: Represa del acueducto de San Esteban, Pto. Cabello, 7 Jan. 1965, *Aristeguieta* 5421 (VEN). ARAGUA: entre Guamilas y Rancho Grande, P.N., 850 m., 6 Oct. 1938, *Williams* 10382 (VEN). FEDERAL DISTRICT: Caracas and vicinity, 3000-3500 ft., 9 Jan. 1921, *Bailey & Bailey* 811 (NY, US). MIRANDA: bosque de Los Guayabitos, arriba de Baruta, Nov. 1964, *Aristeguieta* 5395 (VEN). MERIDA: 3½ miles west of city of Mérida, 5000 ft., 24 Jan. 1931, *Reed* 288 (US). BOLIVAR: San José, Ciudad Bolívar and vicinity, on the Orinoco, about 200 ft., 9 Jan. 1921, *Bailey & Bailey* 811 (BH). **Colombia.** MAGDALENA: Minca road, Santa Marta, 1200 ft., 23 Nov. 1898-1899, *Smith* 2280 (BM, BR, E, F, GH, L, MICH, MO, NY, PH, U, UC, US, VT, WIS). BOLIVAR: Los Hurtados, on Río Sinu, 40-70 m., 4 Feb. 1918, *Pennell* 4153 (NY, US). CHOCO: Andagoya, 70-100 m., 20-30 Apr. 1939, *Killip* 35075 (BM, MO, US). ANTIOQUIA: vicinity of Medellín, 10 Mar. 1927, *Toro* 37 (NY, US). SANTANDER: Puerto Wilches and vicinity, 100 m., 28 Nov.-2 Dec. 1926, *Killip & Smith* 14773 (NY). VALLE DEL CAUCA: Estero de Congrejo, north shore of Buenaventura Bay, near sea level, 3 June 1944, *Killip & Cuatrecasas* 38730 (F, US). CALDAS: Santa Cecilia, Cordillera Occidental, Vertiente Occidental, 800 m., 16 Feb. 1945, *von Sneidern* 5181 (US). TOLIMA: "La Trinidad," Libano, 1000-1200 m., 21-25 Dec. 1917, *Pennell* 3363 (NY). **Ecuador.** PICHINCHA: entre Santo Domingo y la Hcda. Lelia, Sección Occidental, 400-800, 950-1100 m., 11 Aug. 1945, *Acosta-Solís* 10937 (F, US). IMBABURA: entre El Pajón y Cachaco, 600, 740 m., 30 May-12 June 1949, *Acosta-Solís* 12728 (F, US). **Perú.** TUMBES: a 8 km. al sur de Tumbes, 15-20 m., 24 Apr. 1949, *Ferreyra* 6002 (US). LORETO: near km. 194 below Divisoria on road from Tingo Maria to Aguaytia, Prov. Coronel Portillo, ca. 1400 m., 22 Dec. 1960, *Moore, Jr., Salazar C. & Smith* 8632 (BH). JUNIN: La Merced, ca. 700 m., 29 May-4 June 1929, *Killip & Smith* 23416 (NY, US). **Guyana.** POMEROON DISTRICT: Mora Landing, Moruka River, 21-23 Aug. 1922, *De La Cruz* 1844 (BH, F, GH, MO, NY, US). **Surinam.**

Suriname R. near Gansee, 15 Nov. 1933, *Lanjouw* 1307 (NY, U, US). **Dominican Republic.** Madre Vieja, Nagua, Prov. Maria Trinidad Sánchez, 20 Dec. 1964, *Jimenez* 5108 (NY). **Puerto Rico.** San Juan, 14 km. S on Mil. Road, 2 Mar. 1899, *Heller & Heller* 662 (F, NY, US). **Guadeloupe.** 1895, *Duss* 3619 (F, NY, US). **Dominica.** prope Wotten Waven, 200 m., Dec. 1887, *Eggers* 690 (BR, CORD, GOET, L, M, UC). **Martinique.** La riviere du Galion (Trinite) et de la riviere du Carbet, Oct. 1888, *Duss* 1024 (NY). **St. Vincent.** 1000 ft., March 1890, *Smith & Smith* 1660 (BM). **Trinidad.** North Range, roadside forest, Arima Valley Road, 500 m., 24 Mar. 1959, *Cowan & Simmonds* 1180 (NY, US).

*Tripogandra serrulata* may be easily distinguished from other species by its gray or gray-brown seeds with lighter colored reticulations which produce a cobweb pattern over the surface.

Within *Tripogandra serrulata* there is variation in leaf shape as well as in the vesture of leaves, peduncles, pedicels, and sepals. I have not seen any consistency or pattern in this variation. This does not of necessity mean that none exists, however, only that my study has not been precise enough and that the information available to me has not been complete.

Many of the specimens associated with this species have been identified in the past as *Tripogandra cumanensis*. This seems to be the result of a misidentification of specimens by Clarke. The name which has priority is *Commelina serrulata*. *Tradescantia cumanensis* is cited as a synonym of *Tripogandra multiflora* and is discussed under that species.

Vahl's description of *Commelina serrulata* agrees well with the type specimen, but does not mention the stamens or the seeds. It would be difficult to know from the description alone to which species or even genus this specimen should be referred. The specimen has nearly mature seeds which have a reticulation matching that on plants which recent taxonomists have called *Tripogandra cumanensis*. The stamens follow the diagnostic *Tripogandra* pattern; they are dimorphic with the shorter ones opposite the

sepals. It was probably because of the dimorphic stamens that Vahl placed this species in the genus *Commelina*. The name *Commelina serrulata* has not been used in recent years but the type specimen is undoubtedly a *Tripogandra*. Kunth (1843) included this species in the genus *Commelina* in a section called "Species valde dubiae," indicating that he was not certain what the plant was. His decription was taken from Vahl and in parts is nearly a word-for-word copy, implying that he had probably not seen a specimen.

The problem of the identity of *Tradescantia elongata* has plagued taxonomists for many years. I have not seen the type specimen; it should be a Rodshied collection (Stearn and Williams, 1957) preserved at Göttingen but was not located among the specimens obtained on loan. If *T. elongata* does actually apply to *Tripogandra* it can only apply to the one taxon which seems to occur in the vicinity of the Essequibo River in Guyana. The plants from this area are of great interest and should be studied further. I have examined sixty-one sheets of specimens from this area; all sheets have several inflorescences but none of them have fruits in any stage of development. In addition I mounted pollen in aniline blue-lactophenol from some of the plants identified as *T. elongata* from throughout its range. The pollen does not stain and on that basis is considered to have been inviable when fresh. From personal experience with *T. serrulata* in México and knowledge of the existence of sterile plants within these populations, I have treated all these sterile collections as part of the species *T. serrulata*, but only after studying and describing that species from fertile specimens. The pattern and range of variation within the sterile collections falls within that of fertile plants of *T. serrulata*, except for the peduncle length of three collections from Guyana. The longest peduncles were 5.7, 6.4, and 6.7 cm. while the longest peduncle on fertile *T. serrulata* was 5.1 cm. I do not consider this problem solved. The apparent sterility of these plants must be studied in the field to see if it is characteristic or whether my sample by some quirk is very biased.

*Tripogandra elongata* has been interpreted broadly in the past and three taxa have been included within it. These are *T. diuretica* of southern Brazil, Bolivia, Paraguay, Agentina, and Uruguay, *T. montana* of Central America, and *T. elongata* sensu stricto of eastern Venezuela, Guyana and Surinam. These three taxa are not sympatric in any part of their ranges and are morphologically distinguishable. Therefore, I prefer to recognize *T. diuretica* and *T. montana* as separate and distinct species, while the sterile plants of *T. elongata* are included within *T. serrulata*.

Kunth (1843) proposed the name *Tradescantia schlechtendalii* based on *Schiede* 972, which Schlechtendal had misidentified and called *Commelina mexicana* Presl. Presl's original description contains several points indicating that the plants were different: "Petala caerulea, . . . Stamina tria. Filamenta erecta fertilia hirsuta, duo pistillo breviora, tertium pistillo longius. Antherae . . . apice poro dehiscentibus polliniferia . . . Stylus simplex curvatus. Stigma emarginatum." The Schiede specimen has white petals, six stamens, three longer and three shorter, and a capitate stigma. Kunth proceeded, however, to recognize *Commelina mexicana* Presl as a species of *Tradescantia*. I believe that this name may apply to a species of *Commelina* though I am not certain of this. In any case it certainly is not a species of *Tradescantia* or *Tripogandra*, on the basis of the description given by Presl.

Clarke's variety *β glabrior* of *Tradescantia cumanensis* does not seem to differ from *T. congesta*. Clarke states that the pedicels and sepals are glabrous when, in fact, there are a few hairs to be found on the type specimen though some structures are glabrous. These two collections are certainly conspecific but Clarke considered *glabrior* to be a variety of *T. cumanensis* while *T. congesta* was made a synonym of *T. elongata*.

Plants of *Tripogandra serrulata* have been collected from several Caribbean islands. All of these collections lack seeds except one from Hispaniola. The seeds seem identical

with those of mainland *T. serrulata*. If this plant represents the native and not a recently introduced *Tripogandra*, this gives me further confidence in considering these plants, which have been called *T. elongata*, as conspecific with *T. serrulata*.

19. **Tripogandra silvatica** Handlos, *sp. nov.* TYPE: **México.** VERACRUZ: Montepio, 19 km. al E de Catemaco, 19 Mar. 1965, *Gonzales Quintero* 2239 (Holotype, MICH!; isotype, MSC!).

*Herba* perennis(?); *caulis* decumbens, usque ad 30 cm longus; *internodiis* usque ad 5.5 cm longis, linea unica pilorum instructis, aliter glabris. *Folia* ovata, laminis usque ad 2.9 cm longis, usque ad 1.4 cm latis, basi obliquis, apice acutis, dorsaliter glabris, ventraliter glabris vel pilis dispersis instructis praeter lineam partialem pilorum secus costam, margine ciliatis, vaginis usque ad 5.6 mm longis, usque ad 3.0 mm diam., orificio villosis vel pilis dispersis praeditis, linea unica pilorum instructis, aliter glabris. *Inflorescentiae* terminales, ex 1 (-3) cincinnis duplicibus constantes; *pedunculi* usque ad 2.3 cm longi, glabri vel pilis capitatis paucis dispersis instructi; *cincinni* duplices omnes alabastra, flores, vel fructus usque ad 13 gerentes; *pedicelli* usque ad 4.5 mm longi, maturitate reflexi, glabriusculi ad pilosi, bracteis basi pedicellorum glabris, margine erosis, nonnunquam ciliatis. *Flores* albi; *sepala* ovata, cucullata, usque ad 3.7 mm longa, usque ad 1.6 mm lata, pilis capitatis pilosa, margine hyalina, apice ± obtusa; *petala* usque ad 4 mm longa; *stamina* 6 in verticillis duobus, 3 sepalis opposita filamentibus brevibus, usque ad 1.3 mm longis, glabris vel ?pilis paucis moniliformibus praeditis, antheris usque ad 0.5 mm longis, usque ad 0.6 mm latis, 3 petalis opposita filamentibus longioribus, usque ad 2.7 mm longis, glabris, distaliter sigmoideis, antheris usque ad 0.7 mm longis, usque ad 0.6 mm latis; *ovarium* usque ad 0.7 mm longum, glabrum, stylo usque ad 0.4 mm longo, stigmate capitellato. *Capsula* obovoidea, usque ad 2.3 mm longa, usque ad 1.5 mm diam., glabra, basi stipitata,

seminibus triangularibus, usque ad 1.2 mm longis, reticulatis, hilo punctiformi.

Distribution and habitat: in the state of Veracruz, México, in the area around Colipa-Misantla and Catemaco; in wet forest lowlands.

Flowering: March and April.

SPECIMENS EXAMINED

**México.** VERACRUZ: Misantla, Mar. 1841, *Liebmann* (C); inter Colipa et Misantla ad Palenque, Mar. 1841, *Liebmann* (C); Colipa, Mar. 1841, *Liebmann* 350 (C); Colipa, Mar. 1841, *Liebmann* (C); Jalapa, 4000 ft., 3 Apr. 1899, *Pringle* 7810 (VT).

Dried specimens of this species resemble *Leiandra cordifolia* superficially — usually bearing only one terminal double cincinnus. Dissection of the flower is necessary to reveal the dimorphic nature of the stamens.

20. **Tripogandra warmingiana** (Seubert) Handlos, *comb. nov.*

*Tradescantia warmingiana* Seubert in Warming, Vidensk. Meddel. Dansk Naturhist. Foren. Kjøbenhavn 126. 1872. HOLOTYPE: **Brazil.** MINAS GERAIS: Lagoa Santa, 6 Mar. 1866, *Warming* 1046 (C!).

Plants annual(?); stem decumbent at the base and rooting at the nodes, to 19 cm long, branched; internodes to 5.6 cm long, glabrous except for a line of uniseriate hairs extending down the side from the sheath above. Leaves narrowly ovate to ovate; blades to 4.4 cm long, to 1.85 cm wide, with the base always oblique but narrowed and subpetiolate on the lower part of the plant, glabrous dorsally, glabrous ventrally except for a line of hairs at the proximal end of the midvein, margin ciliate, apex acute and slightly acuminate; sheaths to 4.4 mm long, to 3.1 mm in diam., sparingly villous at the orifice, otherwise glabrous except for a line of uniseriate hairs extending down the side opposite the blade. Inflorescences composed of 1-3 double cincinni borne terminally and in the upper leaf axils; peduncles to 1.2 cm long, green, glabrous; double cincinni

with up to 8 buds, flowers and/or fruits, pedicels to 4.5 mm long, green, with a few uniseriate hairs near the distal end, reflexed in fruit; bracts at the base of each pedicel glabrous, margin erose. Flowers white; sepals ovate, to 3.4 mm long, to 1.7 mm wide, pilose along the midvein, the remainder with scattered uniseriate hairs, margin hyaline, apex acute; petals ovate-elliptic (fide Warming), to 5.0 mm long, to 2.3 mm wide, apex obtuse (fide Warming); stamens 6, in two whorls, the outer shorter, filaments to 1.2 mm long, glabrous, anthers to 0.7 mm long, to 0.5 mm wide, anther sacs parallel; stamens of the inner whorl longer, filaments to 3.7 mm long, bent in an S-shape (fide sketch, presumably by Warming), bearded in the lower portion of the upper half with moniliform hairs, anthers to 0.5 mm long, to 1.2 mm wide, connective elongate and anther sacs divergent; ovary to 0.9 mm long, 0.8 mm in diam., glabrous, style to 0.5 mm long, stigma minutely capitellate. Capsule globose, to 3.0 mm long, to 2.8 mm in diam., light brown, glabrous; seeds 2 per locule, rounded-triangular, gray or brown, testa reticulate-foveate (Fig. 61), hilum punctiform.

Distribution: known only from three collections at Lagoa Santa, Brazil.

SPECIMENS EXAMINED

**Brazil.** MINAS GERAIS: Lagoa Santa, 10 Mar. 1864, *Warming* 1070 (778) (C); Lagoa Santa, *Warming* (F, US p.p.).

I know this species from only three collections. According to the original description it was found in a wooded area above a rocky calcareous site near Lagoa Santa, Brazil and flowered from January to March.

The original description accords well with the type specimen. One discrepancy exists concerning the shorter stamens. The original description states: "Stamina tria interiora minora, . . ." In fact, the shorter stamens are opposite the sepals and are the outer whorl of stamens.

C. B. Clarke considered this species as part of his *Tradescantia elongata*. The habit and size of the plant.

shape of the laminar base, seeds, flower size and color, and stigma show this species to be distinct.

EXCLUDED SPECIES

*Tripogandra cordifolia* (Swartz) Aristeguieta, Bol. Acad. Ci. Fis. 25:125. 1965.

*Tradescantia cordifolia* Swartz, Nova genera & species plantarum seu prodromus . . . 57. 1788.

*Leiandra cordifolia* (Swartz) Rafinesque, Flora Telluriana 2:16. 1837 ('1836').

*Callisia cordifolia* (Swartz) Anderson & Woodson, Contr. Arnold Arbor. 9:117. 1935.

*Phyodina cordifolia* (Swartz) Rohweder, Abh. Auslandsk., Reihe C, Naturwiss. 18:151. 1956.

I have excluded *Tripogandra cordifolia* because it has six more or less similar, glabrous stamens. The genus *Phyodina* as interpreted by Rohweder is composed of diverse elements which show little affinity. This problem has been discussed to some extent by Moore (1963) but requires much more study in conjunction with a consideration of *Tradescantia gracilis*, *T. debilis*, and *Leptorhoeo filiformis*.

*Tripogandra lundellii* (Standley) Woodson, Ann. Missouri Bot. Gard. 29:153. 1942.

*Tradescantia lundellii* Standley, Publ. Field Mus. Nat. Hist. Bot. Ser. 22:5. 1940. TYPE: *Lundell* 7098 (Holotype F!; isotypes, MICH!, NY!).

*Gibasis* sp.

Standley's original description of *Tradescantia lundellii* described stamens of two lengths. This species cannot be considered one of *Tripogandra* because at anthesis the plants have six essentially similar stamens which are borne on flowers in a single cincinnus.

*Tripogandra rosea* (Ventenat) Woodson, Ann. Missouri Bot. Gard. 29:153. 1942.

*Tradescantia rosea* Ventenat, Jard. Cels 24. 1800. HOLOTYPE: *Michaux* P; photograph, GH!.

*Cuthbertia rosea* (Ventenat) Small, Flora of the Southeastern United States 237. 1903.
*Phyodina rosea* (Ventenat) Rohweder, Abh. Auslandsk., Reihe C, Naturwiss. 18:151. 1956.

*Tripogandra rosea* lacks the dimorphic stamens which characterize *Tripogandra sensu stricto*. Rohweder's inclusion of this species in *Phyodina* should be investigated further.

*Tripogandra stenophylla* (Brandegee) Matuda, Anales Inst. Biol. Univ. Nac. México 26:369. 1956 ('1955').
*Tradescantia stenophylla* Brandegee, Univ. Calif. Publ. Bot. 3:377. 1909. TYPE: *Purpus* 3352 (Holotype, UC!; isotype, NY!).

*Tripogandra stenophylla* is properly placed in the genus *Tradescantia* because this plant has six similar stamens and two foliaceous bracts subtending the double cincinnus.

*Tripogandra warscewicziana* (Kunth & Bouche) Woodson, Ann. Missouri Bot. Gard. 29:154. 1942.
*Tradescantia warszewicziana* Kunth & Bouche, Ind. Sem. Hort. Berol. 11. 1847.
*Spironema warszewiczianum* (Kunth & Bouche) Brückner, Notizbl. Bot. Gart. Berlin-Dahlem 10:56. 1927.
*Phyodina warscewicziana* (Kunth & Bouche) Rohweder, Abh. Auslandsk., Reihe C, Naturwiss. 18:151. 1956.
*Hadrodemas warszewicziana* (Kunth & Bouche) Moore, Baileya 10:134. 1963 ('1962').

*Tripogandra warscewicziana* must be excluded because of its inflorescence structure and a lack of dimorphic stamens. Moore (1963) has more fully discussed the placement of this unusual species.

*Descantaria laxiflora* (Clarke) Brückner, Notizbl. Bot. Gart. Berlin-Dahlem 10:56. 1927.
*Tradescantia laxiflora* Clarke in DC, Monographiae Phanerogamarum 3:307. 1881. TYPE: *Andrieux* 51 (Holotype, K!; isotype, M!).
*Gibasis* sp.

This species has a single cincinnus so it cannot be considered a species of *Tripogandra*.

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BOTANY DEPARTMENT
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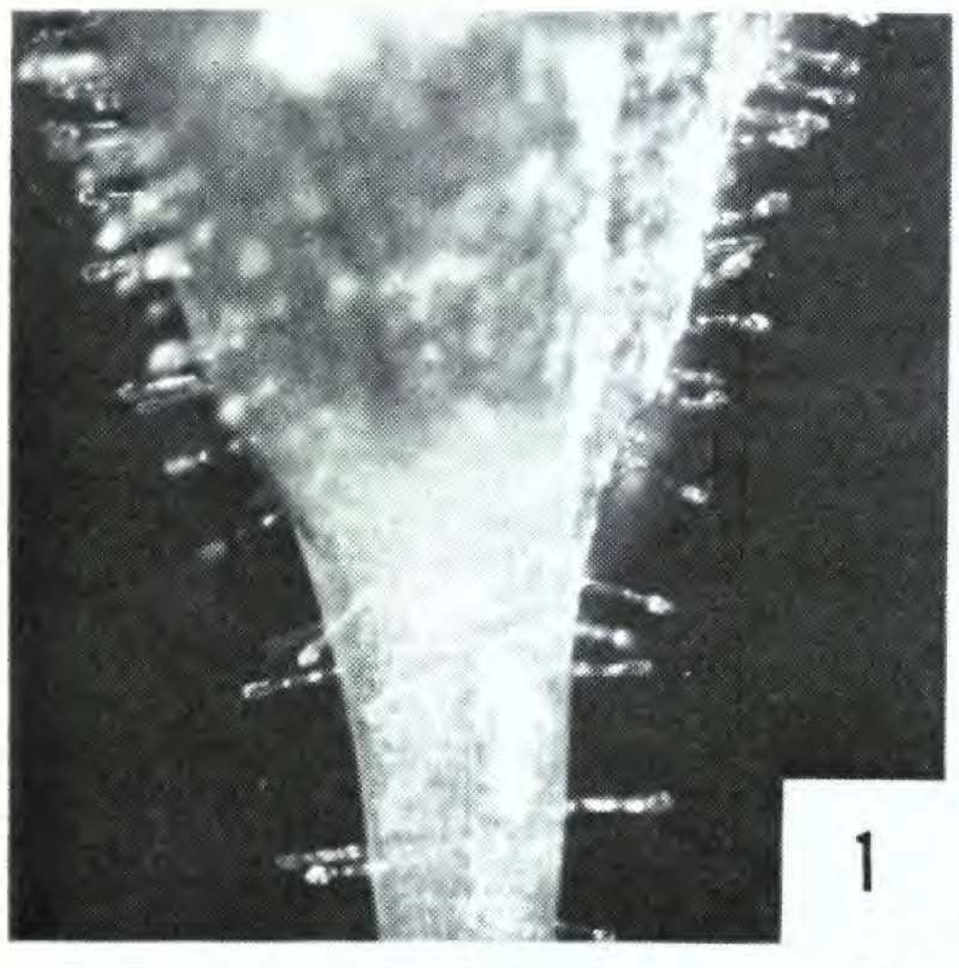
Fig. 1. Upper pedicel and lower calyx of *Tripogandra purpurascens* bearing capitate hairs. × 17.

Fig. 2. Upper pedicel and lower calyx of *T. saxicola* bearing uniseriate hairs. × 17.

Fig. 3. Upper pedicel and lower calyx of *T. serrulata*. × 17.

Fig. 4. Sheathing leaf base and node of *T. serrulata* showing a continuous line of uniseriate hairs on the sheath and internode. × 11.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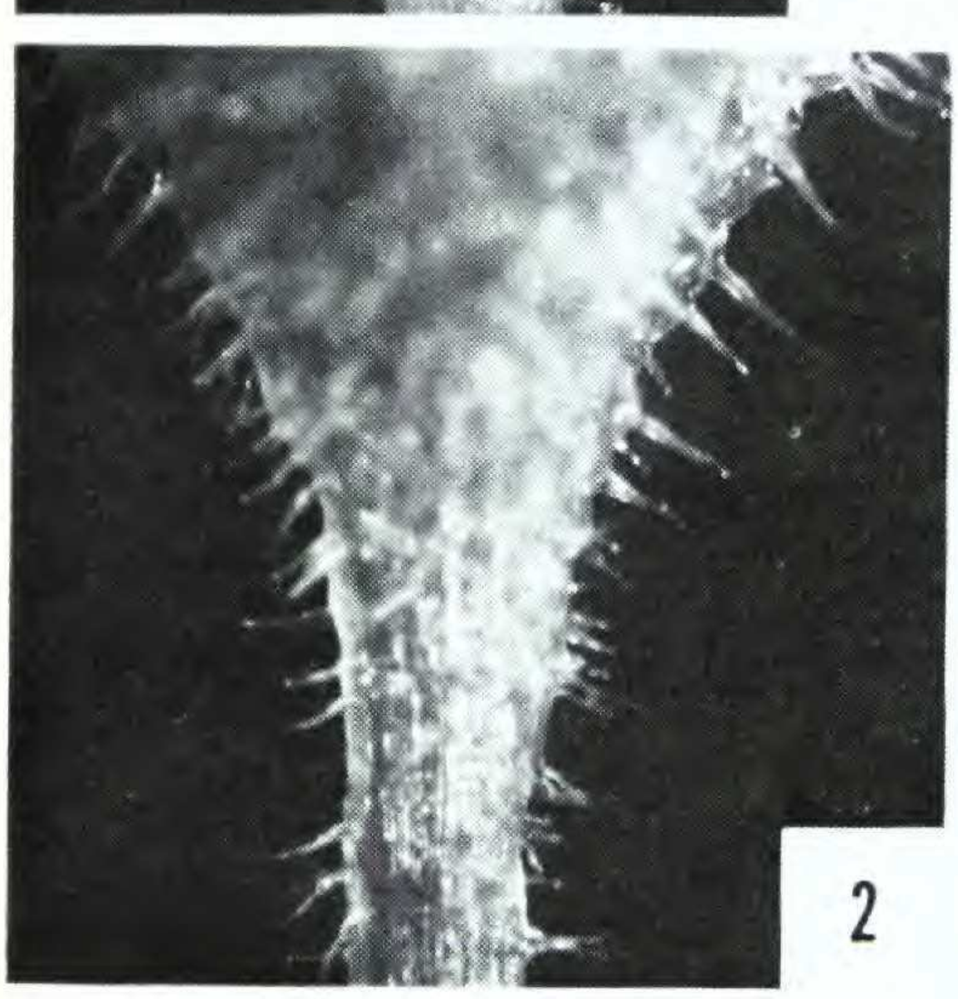
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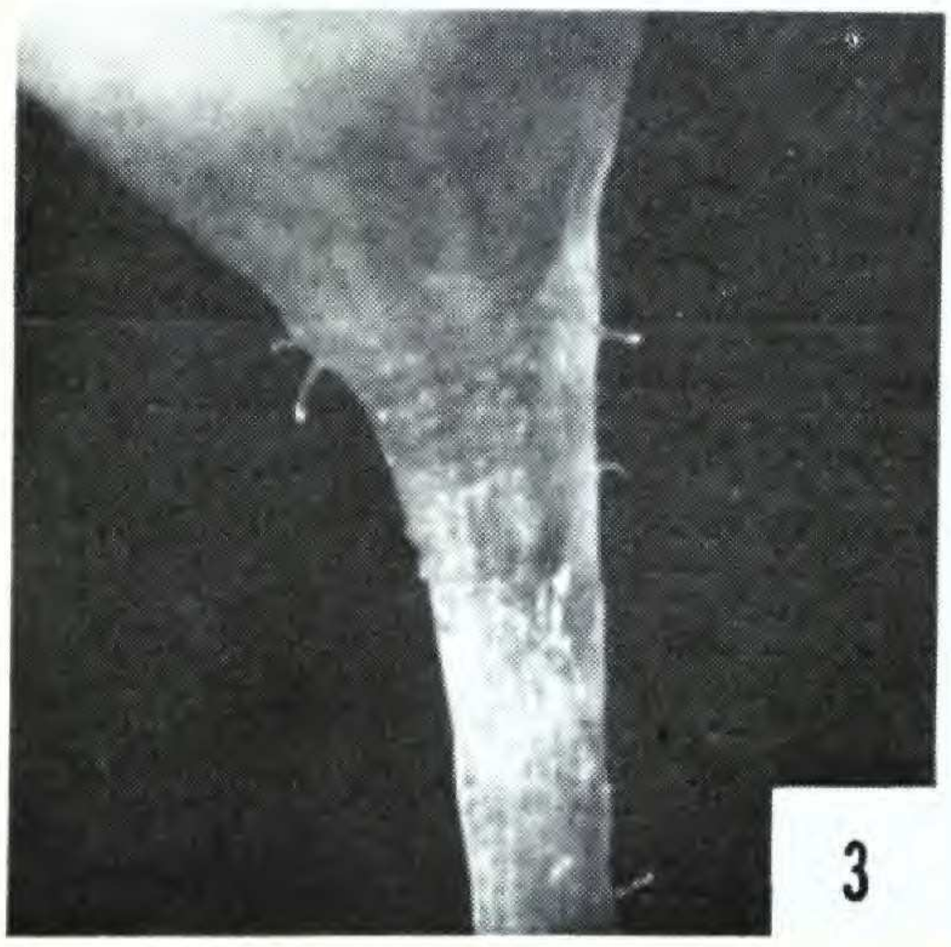
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Fig. 5. Outer stamen of *Tripogandra purpurascens*. × 11.
Fig. 6. Stamen of *T. amplexans*. × 11.
Fig. 7. Stamen of *T. amplexicaulis*. × 11.
Fig. 8. Stamen of *T. grandiflora*. × 11.
Fig. 9. Stamen of *T. grandiflora*. × 11.
Fig. 10. Outer stamen of *T. montana*. × 11.
Fig. 11. Stamen of *T. guerrerensis*. × 11.
Fig. 12. Outer stamen of *T. saxicola*. × 22.
Fig. 13. Stamen of *T. palmeri*. × 22.
Fig. 14. Stamen of *T. angustifolia*. × 22.


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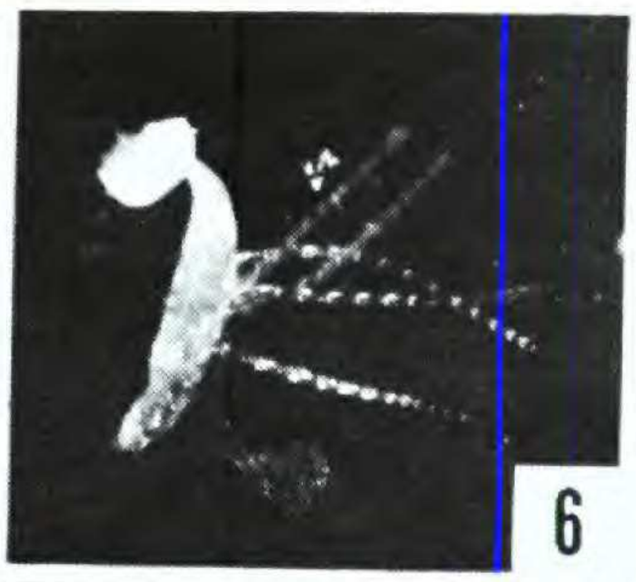
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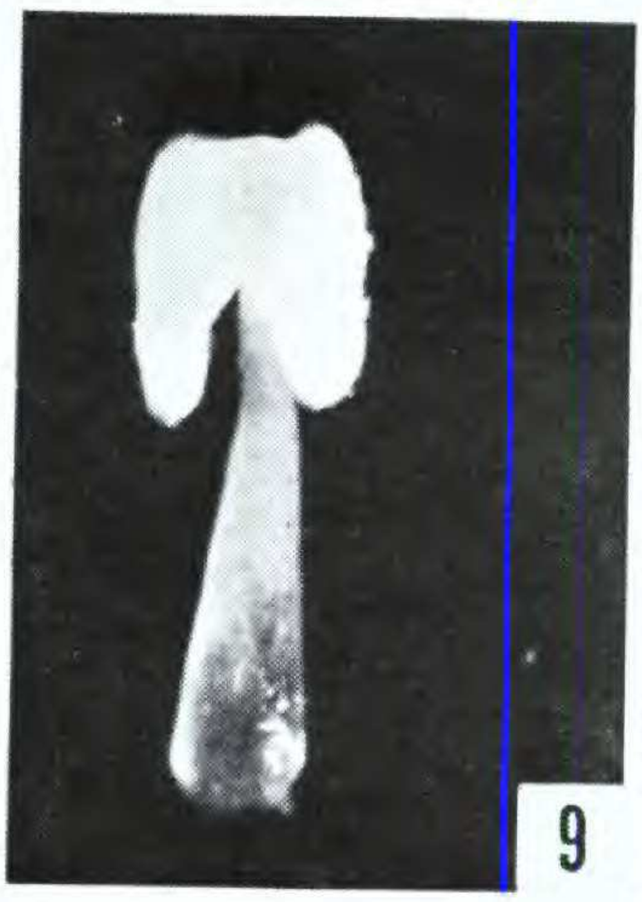
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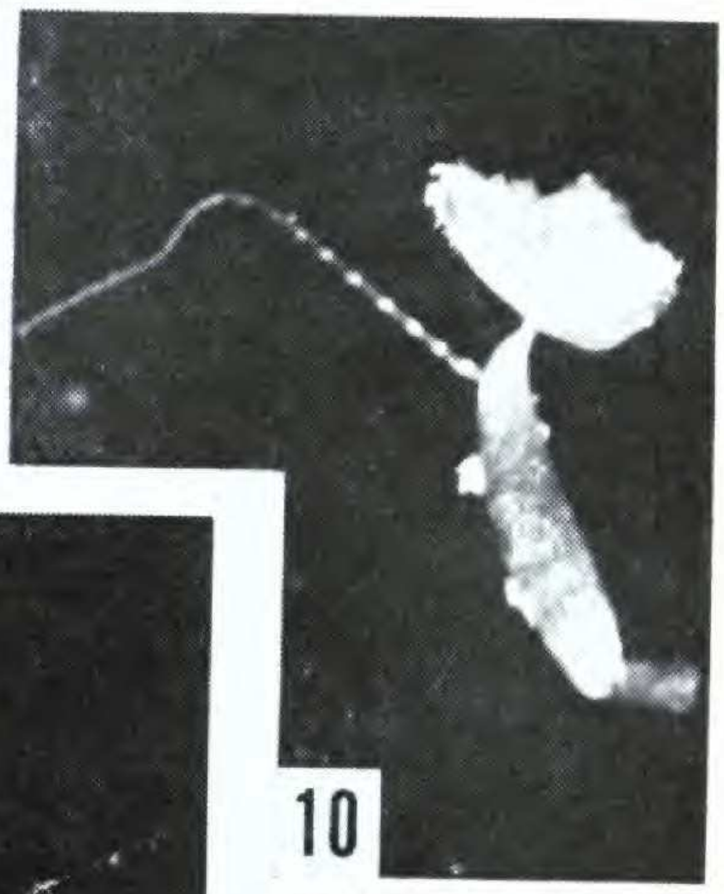
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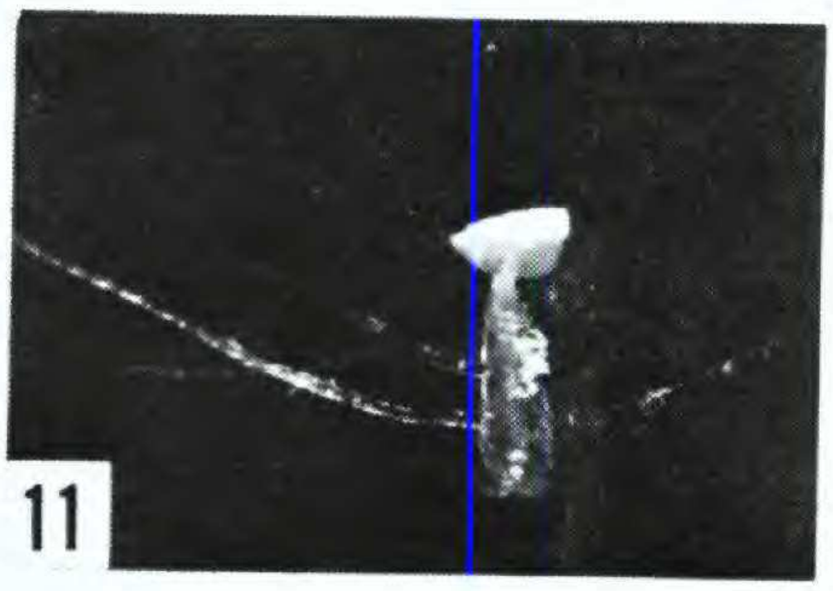
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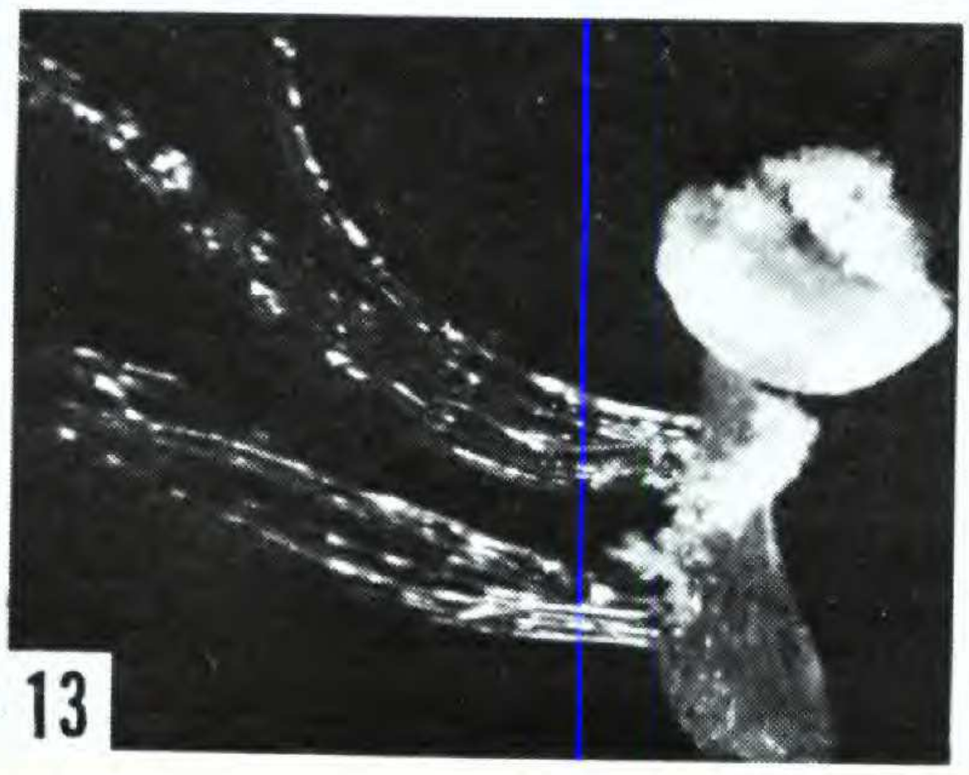
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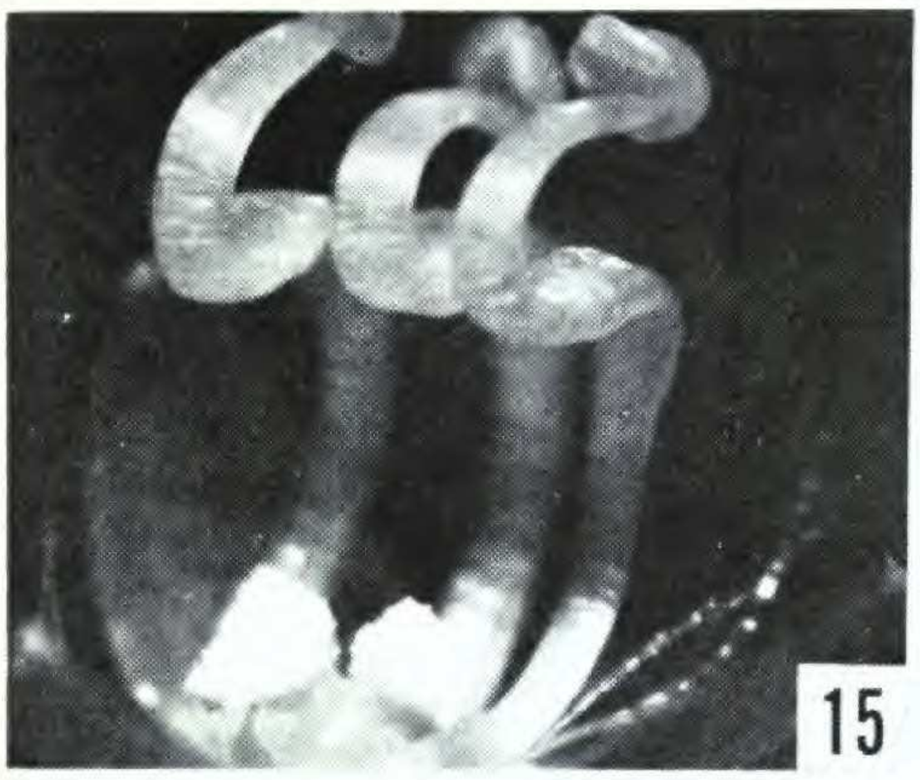
Fig. 15. Androecium of *Tripogandra guerrerensis*. × 11.
Fig. 16. Flower of *T. serrulata*. × 7.5.
Fig. 17. Staminode of *T. guerrerensis*. × 11.
Fig. 18. Inner stamen of *T. purpurascens*. × 11.
Fig. 19. Inner stamen of *T. serrulata*. × 11.
Fig. 20. Inner stamen of *T. saxicola*. × 11.
Fig. 21. Staminode of *T. palmeri*. × 11.
Fig. 22. Staminode of *T. palmeri*. × 11.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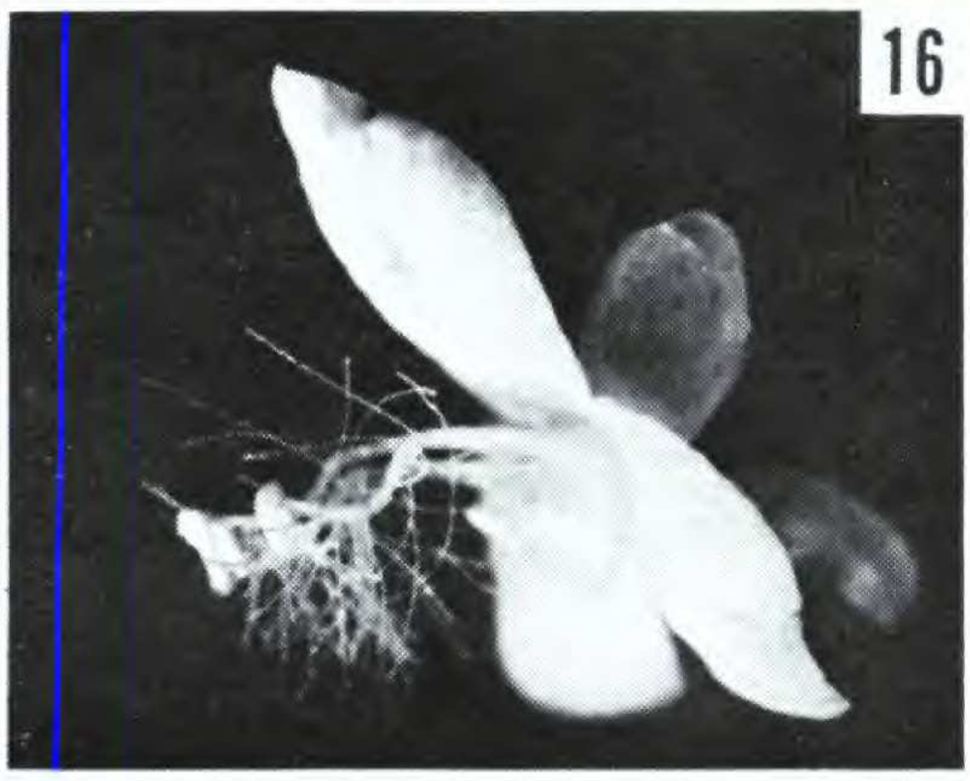
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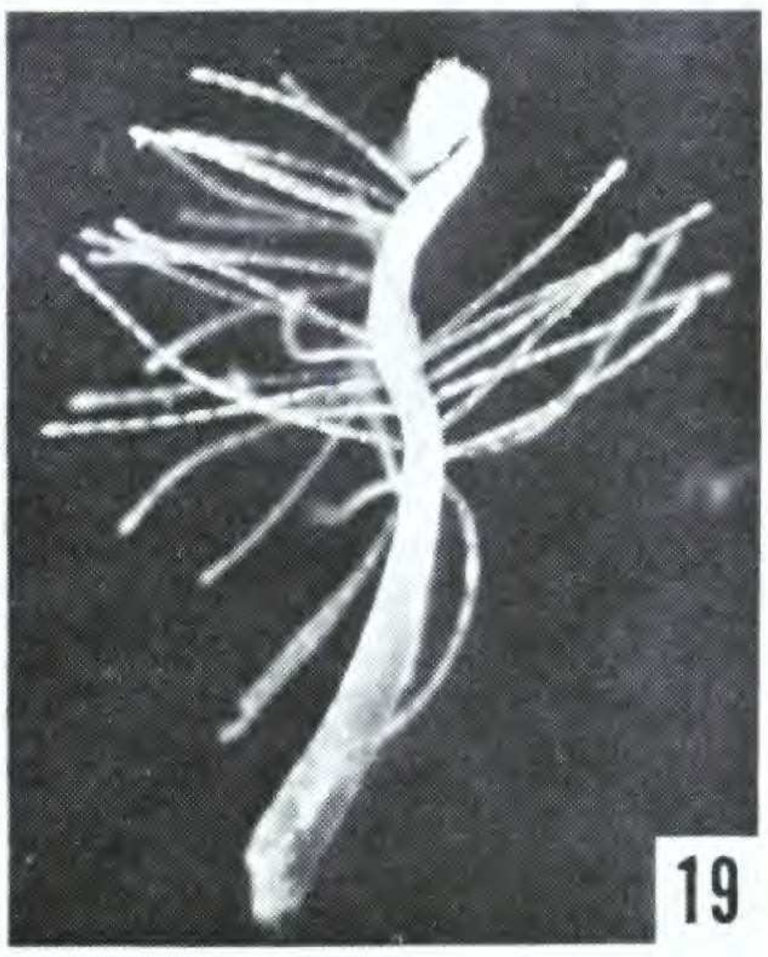
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Fig. 23. Distal portion of staminode of *Tripogandra amplexicaulis* showing the inflated filament. × 11.

Fig. 24. Germinating seed of *T. purpurascens* showing the emerging radicle and capping embryotega. × 34.5.

Fig. 25. Androecium and gynoecium of *T. amplexans* showing the relative positions of stamens and staminodes. × 11.

Fig. 26. Staminode of *T. amplexans*, lateral view. × 11.

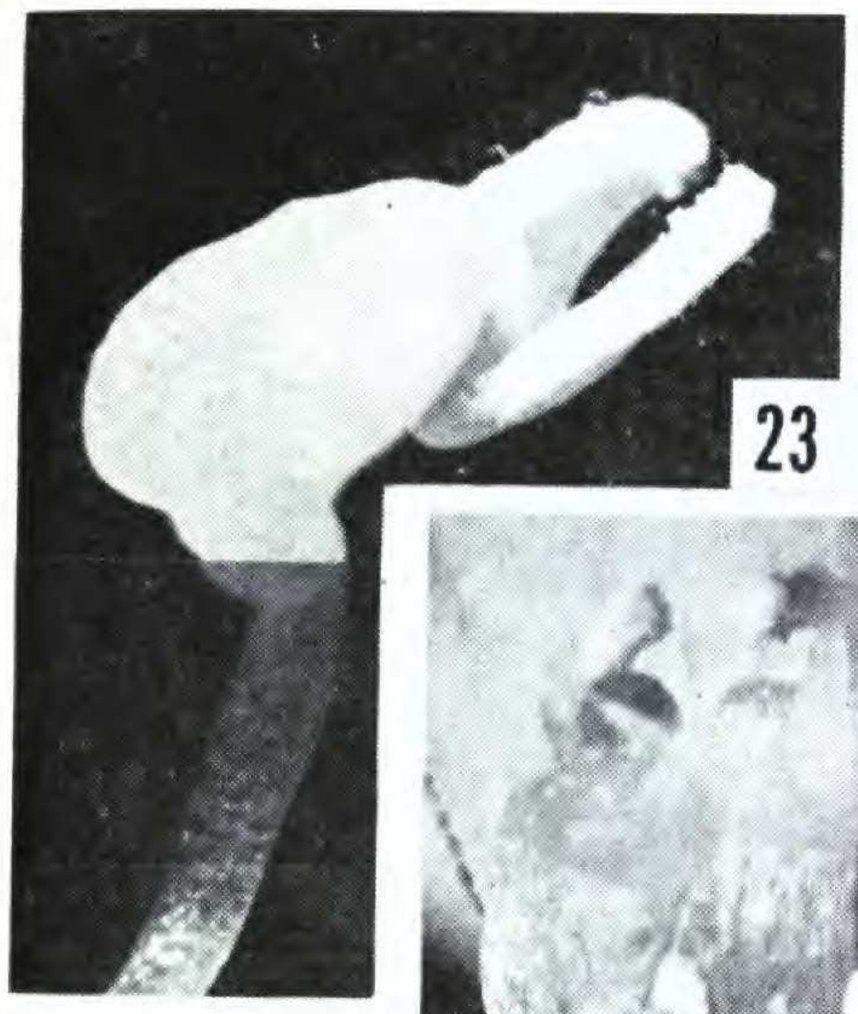
Fig. 27. Distal portion of filament and anther of *T. angustifolia*. × 22.

Fig. 28. Distal portion of staminode of *T. grandiflora*. × 11.

Fig. 29. Staminode of *T. amplexicaulis-T. amplexans* intermediate. × 11.

Fig. 30. Staminode of *T. angustifolia*. × 16.

Fig. 31. Distal portion of inner stamen of *T. montana*. × 11.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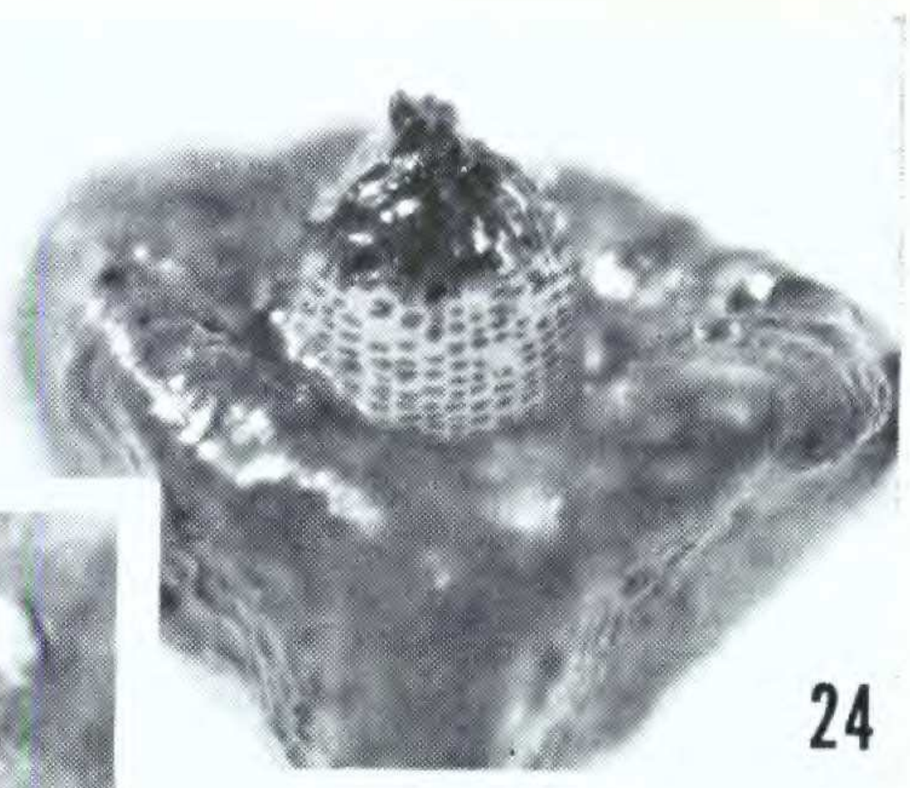
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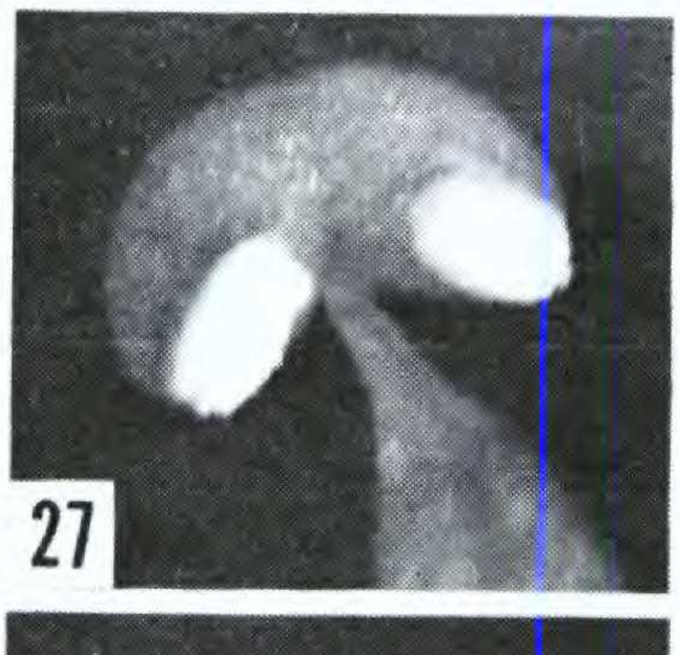
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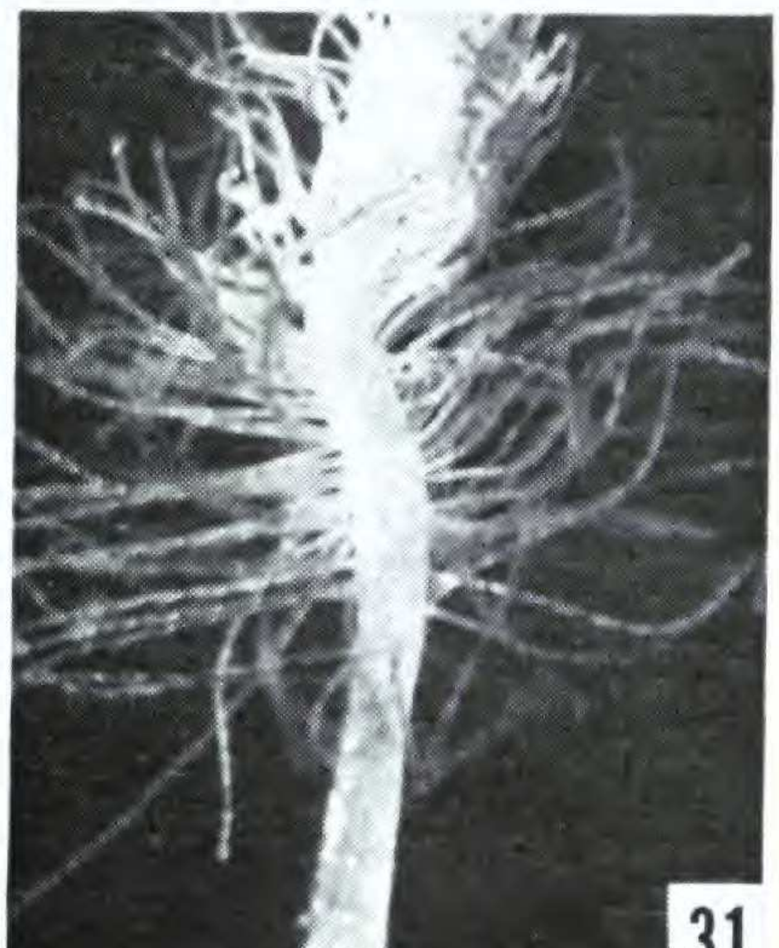
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Fig. 32. Seed of *Tripogandra multiflora*, dorsal surface.

Fig. 33. Seed of *T. multiflora*, ventral surface showing punctiform hilum.

Fig. 34. Seed of *T. multiflora*, dorsal surface.

Fig. 35. Seed of *T. multiflora*, ventral surface showing punctiform hilum.

Fig. 36. Seed of *Tradescantia triandra*, dorsal surface.

Fig. 37. Seed of *T. triandra*, ventral surface showing punctiform hilum.

Fig. 38. Seed of *Tripogandra serrulata*, dorsal surface.

Fig. 39. Seed of *T. serrulata*, ventral surface showing punctiform hilum.

Fig. 40. Seed of *T. diuretica*, dorsal surface.

Fig. 41. Seed of *T. diuretica*, ventral surface showing punctiform hilum.

Fig. 42. Seed of *T. glandulosa*, dorsal surface.

Fig. 43. Seed of *T. glandulosa*, ventral surface showing punctiform hilum.

Fig. 44. Seed of *T. montana*, dorsal surface.

Fig. 45. Seed of *T. montana*, ventral surface showing punctiform hilum.

Fig. 46. Seed of *T. montana*, lateral surface.

Fig. 47. Seed of *T. brasiliensis*, dorsal surface.

Fig. 48. Seed of *T. brasiliensis*, ventral surface showing elliptical hilum.

Fig. 49. Cleared ovary of *T. guerrerensis* showing two seeds, the upper larger and the lower smaller, and the dorsal bundle of one carpel.

The scale represents 1 mm.


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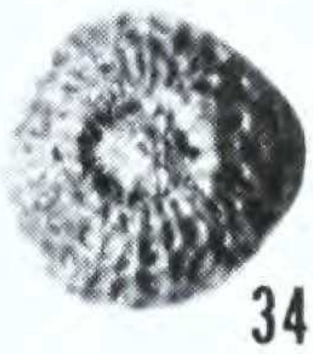
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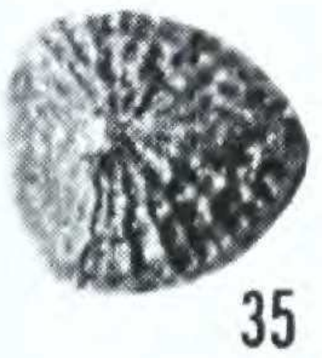
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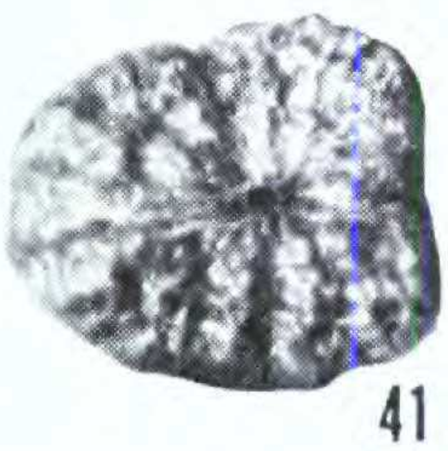
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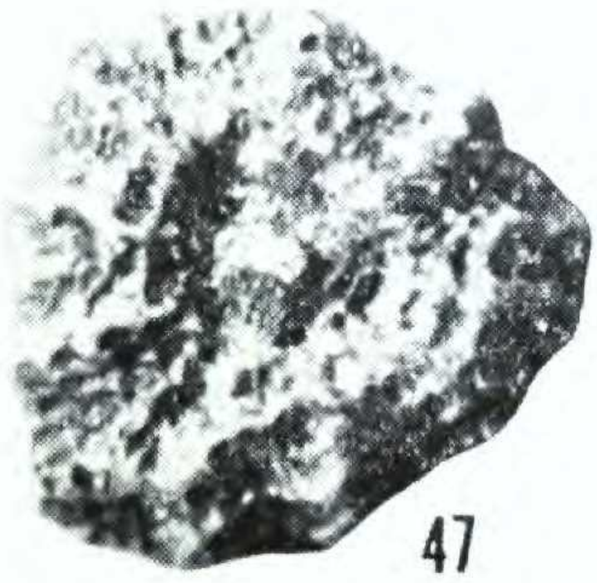
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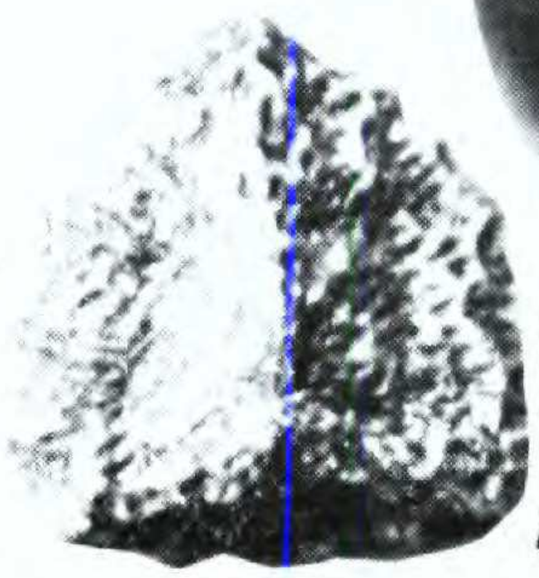
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Fig. 50. Seed of *Tripogandra purpurascens* subsp. *purpurascens*, dorsal surface.

Fig. 51. Seed of *T. purpurascens* subsp. *purpurascens*, ventral surface showing punctiform hilum.

Fig. 52. Seed of *T. disgrega*, dorsal surface.

Fig. 53. Seed of *T. disgrega*, ventral suface showing punctiform hilum.

Fig. 54. Seed of *T. purpurascens* subsp. *australis*, dorsal surface.

Fig. 55. Seed of *T. purpurascens* subsp. *australis*, ventral surface showing punctiform hilum.

Fig. 56. Seed of *T. saxicola*, dorsal surface.

Fig. 57. Seed of *T. saxicola*, ventral surface showing punctiform hilum.

Fig. 58. Seed of *T. amplexans*, dorsal surface.

Fig. 59. Seed of *T. amplexans*, dorsal surface.

Fig. 60. Seed of *T. amplexans*, ventral surface showing linear hilum.

Fig. 61. Seed of *T. warmingiana*, dorsal surface.

Fig. 62. Seed of *T. amplexicaulis-T. amplexans* intermediate, dorsal surface.

Fig. 63. Seed of *T. amplexicaulis-T. amplexans* intermediate, ventral surface.

Fig. 64. Seed of *T. amplexicaulis*, dorsal side showing alveolate surface.

Fig. 65. Seed of *T. amplexicaulis*, ventral side showing linear hilum and alveolate surface.

Fig. 66. Seed of *T. amplexicaulis*, dorsal surface.

Fig. 67. Seed of *T. amplexicaulis*, ventral surface showing linear hilum.

The scale represents 1 mm.


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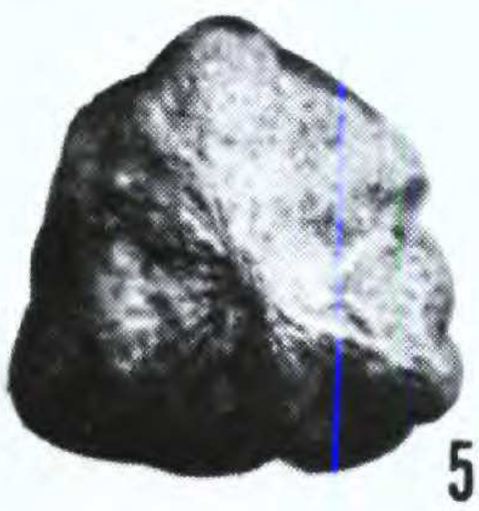
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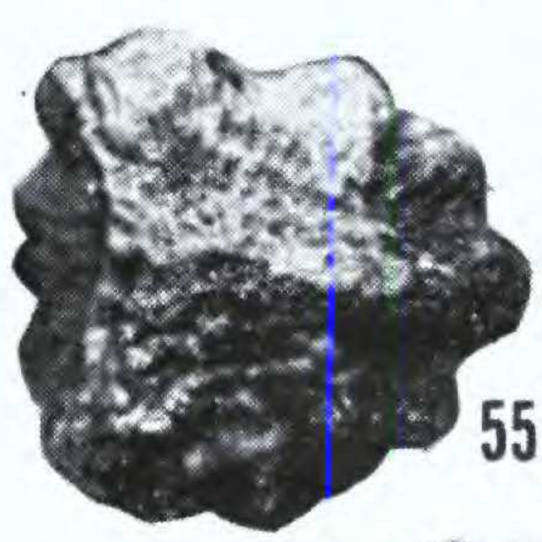
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Fig. 68. Seed of *Tripogandra guerrerensis*, dorsal surface, lower seed of the locule.

Fig. 69. Seed of *T. guerrerensis*, ventral surface showing elliptical hilum, lower seed of the locule.

Fig. 70. Seed of *T. guerrerensis*, dorsal surface, upper seed of the locule.

Fig. 71. Seed of *T. guerrerensis*, ventral surface showing elliptical hilum, upper seed of the locule.

Fig. 72. Seed of *T. palmeri*, dorsal surface.

Fig. 73. Seed of *T. palmeri*, ventral surface showing linear hilum.

Fig. 74. Seed of *T. angustifolia*, dorsal surface.

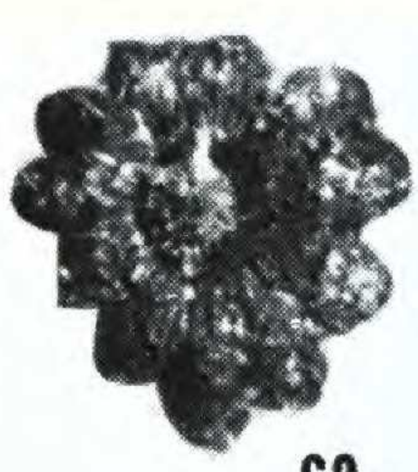
Fig. 75. Seed of *T. angustifolia*, ventral surface showing punctiform hilum.

Fig. 76. Seed of *T. grandiflora*, dorsal surface.

Fig. 77. Seed of *T. grandiflora*, dorsal surface.

Fig. 78. Seed of *T. grandiflora*, ventral surface showing linear hilum.

The scale represents 1 mm.



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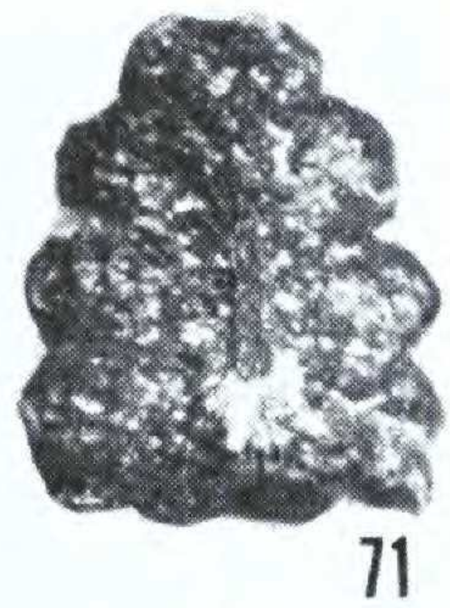

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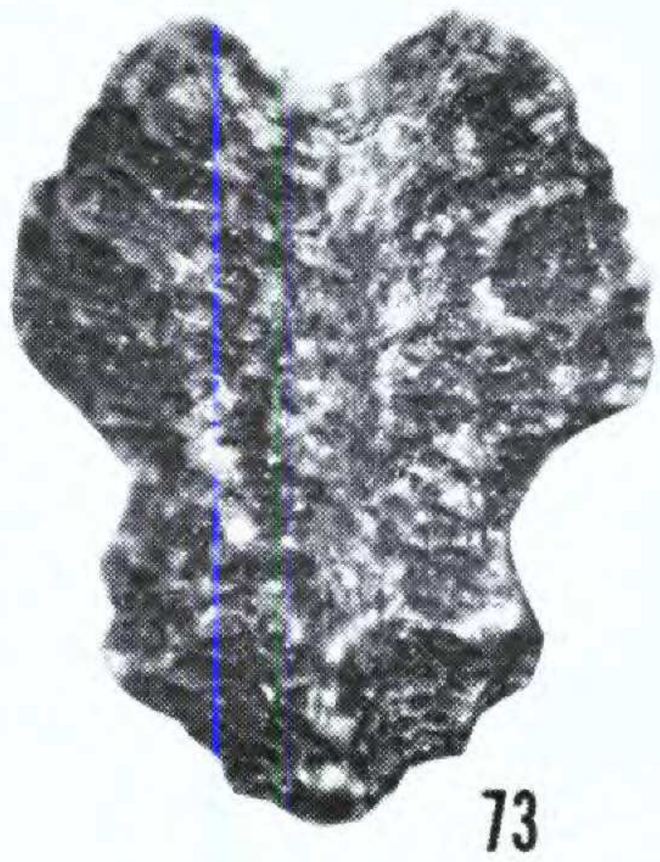

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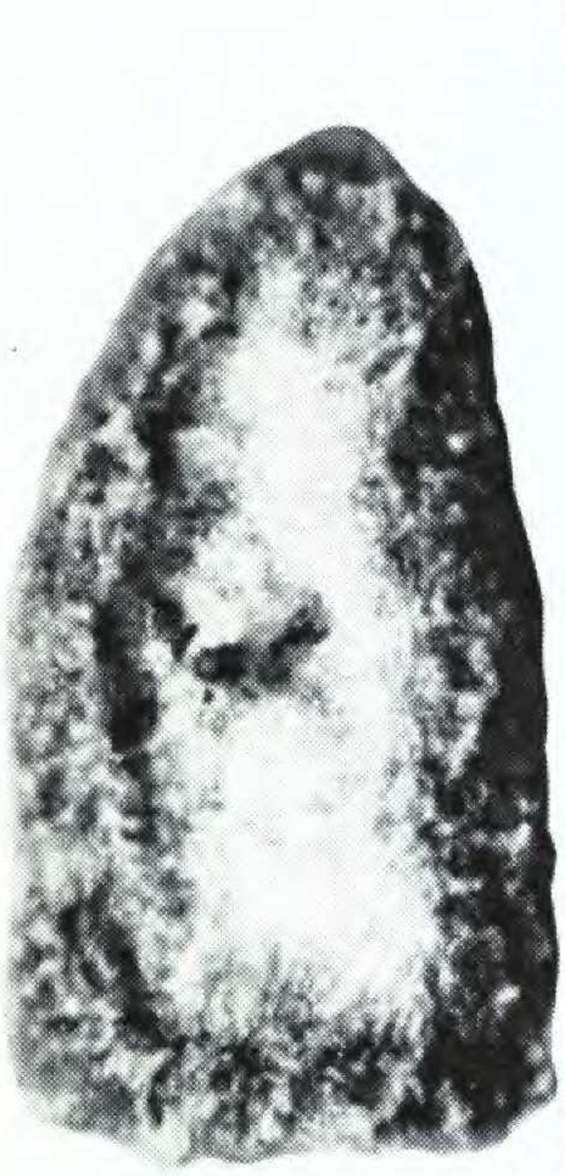

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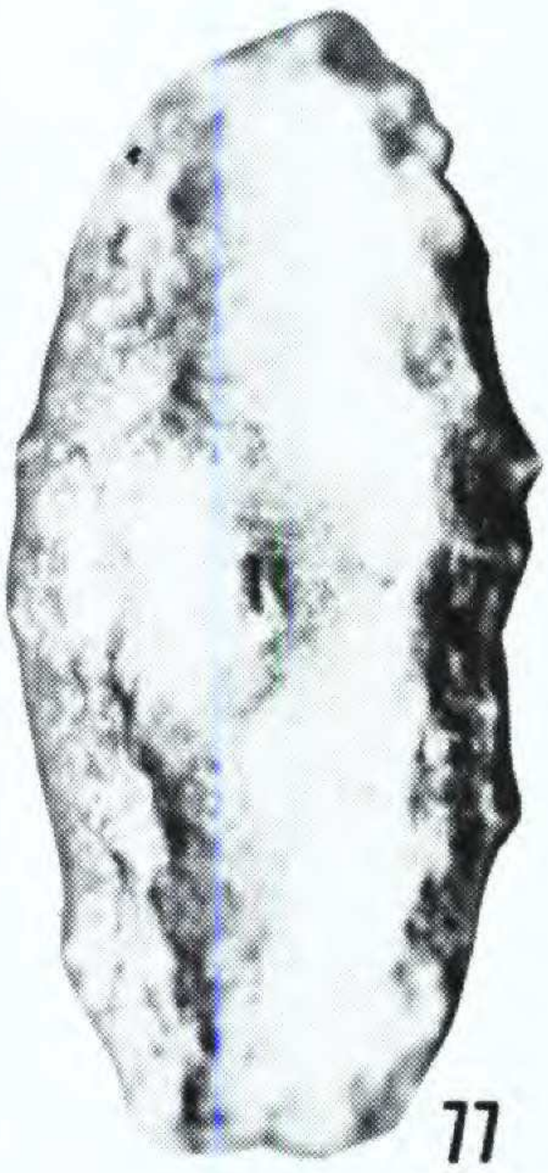

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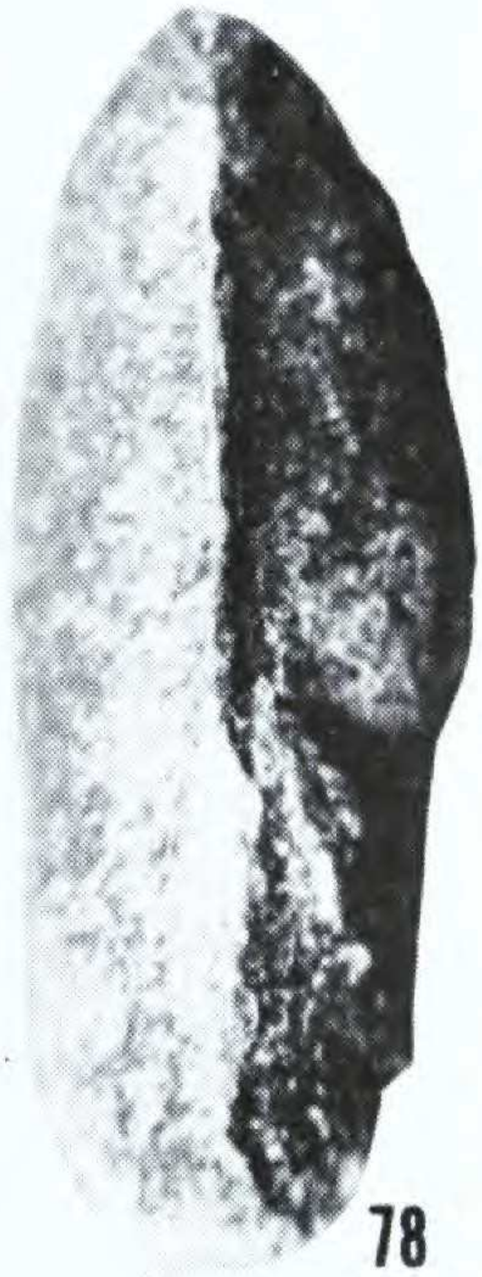

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